EVALUATING THE ROLE OF THE AUTOMOBILE A MUNICIPAL STRATEGY

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EVALUATING THE ROLE OF THE AUTOMOBILE: A MUNICIPAL STRATEGY

Healthy City Office

City of Toronto
& the Technical Workgroup on
Traffic Calming &
Vehicle Emission Reduction

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PREFACE

The Healthy City Office wishes to thank the members of the Technical Workgroup on Traffic Calming and Vehicle Emission Reduction who have contributed to a strategy which can help improve the quality of life for all Torontonians:

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EXECUTIV

GENESIS OF THIS REPORT The Technical Workgroup on Traffic Calming and Vehicle Emission Reduction was established in February 1989 to: 1) prepare a long-term strategy to reduce traffic and vehicle emissions in Toronto, and 2) assess the feasibility of "traffic calming" (the reduction of traffic volume and traffic speed) and emission reduction measures for Toronto. ¶ The workgroup, with representation from municipal government, Toronto Transit Commission, GO Transit, business, environmental groups, and ratepayers prepared this report, coordinated by the Healthy City Office, to assist City Council in developing a strategy to achieve a more liveable city through the reduction of traffic and air pollution. ¶ The committee has made 74 recommendations to reduce the negative health, social and environmental impacts of motor vehicles in and around the city of Toronto. In assessing the various options for a transportation strategy, the committee was guided by the principles of: sustainability, coordination and integration, quality of life, social equity, and community involvement. **COST OF THE CAR: CAN WE AFFORD IT?** Motor vehicles have a major impact on the quality of life in urban areas. While we enjoy the convenience of the automobile, it is the least energy efficient form of transportation, the most polluting, and requires the most road space on a per capita basis. In addition, traffic emissions contribute significantly to poor health, environmental damage, the greenhouse effect, noise pollution and the loss of non-renewable resources. ¶ The following facts illustrate the impact automobiles have had and will have on the Toronto area: *The number of vehicles crossing the Metro boundary during the morning peak period has increased by about 150% since 1975, and by 20% into the downtown core.* 🚗 *Eighty-four percent of people* *coming from outside Metro and crossing into Metro Toronto during morning rush hour use their cars. These represent 19% of all the trips made into Metro.*

Fifty-two percent of morning peak period trips which begin and end in Metro are made by car. The number of motor vehicle trips per person per day in Metro has almost doubled over the past 30 years. The average car crossing all Metro and City boundaries is carrying fewer people today than 15 years ago. Over the past 25 years, vehicle trips in the Greater Toronto Area have increased at twice the rate of the population. In 1990 it is estimated that 16.5 kilotonnes of CO_2, (carbon dioxide), 63 tonnes of NO_X (nitrogen oxides), and 103 tonnes of VOC (volatile organic compounds) were emitted every day from motor vehicles in the Greater Toronto Area. The total quantity of pollutants from vehicles increased by 18% in Toronto from 1982 to 1985.

If present population and consumer trends continue, vehicle ownership and road traffic in Metro Toronto will likely double over the next 35 years.

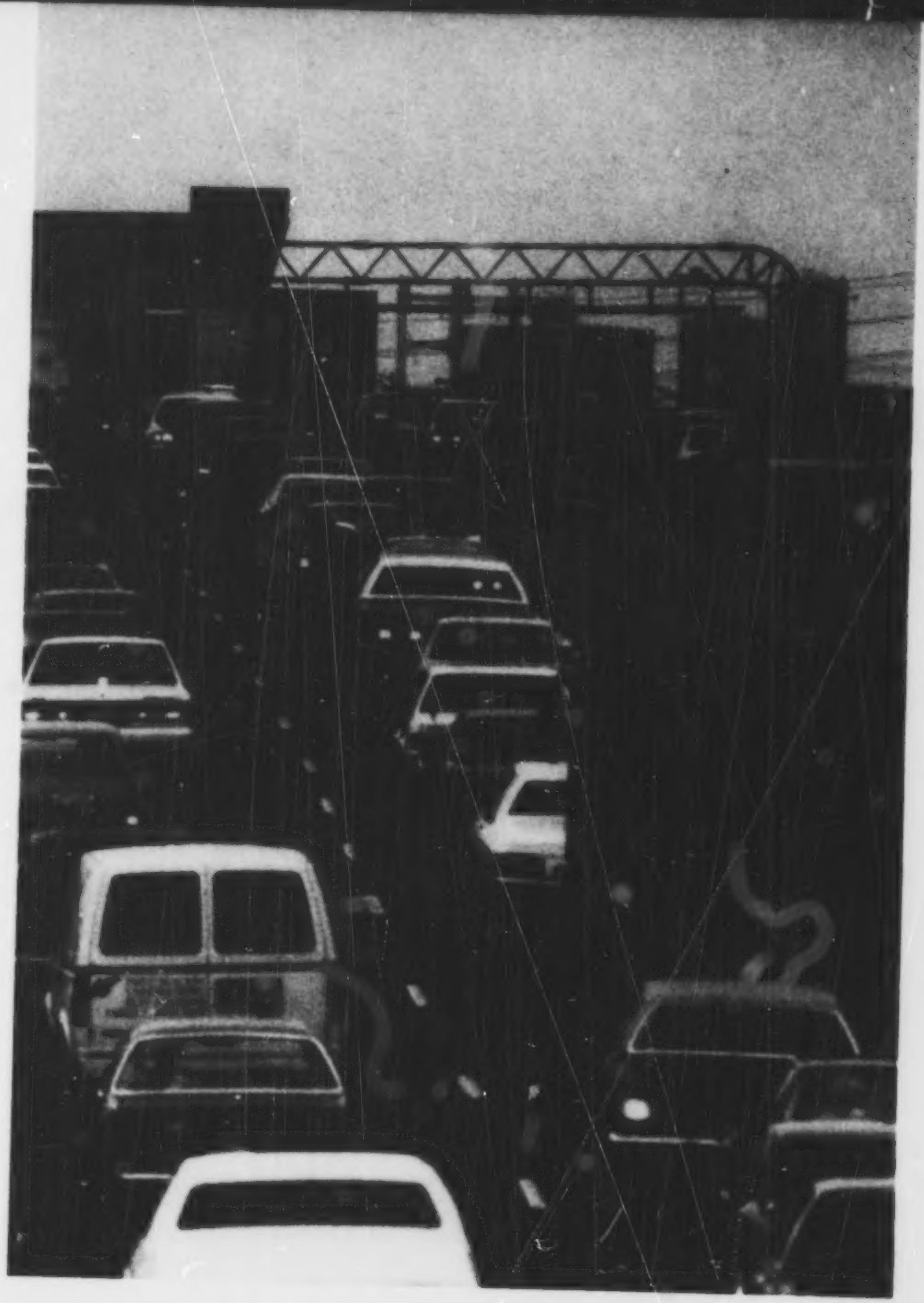
IMPACT ON INDIVIDUAL HEALTH There are five major air pollutants present in the exhaust emission of gasoline-burning cars: nitrogen oxides (NO_X), carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbons (HC) and suspended particulates (SP). In addition, nitrogen oxides and hydrocarbons interact in sunlight to produce a sixth pollutant, ozone. ¶ Air pollution aggravates coughs and sore throats, hampers breathing in asthmatics and prevents lungs from functioning properly. Bronchitis, asthma and emphysema can be long-term effects from air pollution. Urban areas have higher rates of death from lung cancer and lung diseases than rural areas, which may be due in part to air pollution. ¶ In addition, the largest cause of accidental fatalities in Metro Toronto are from motor vehicles, including injuries to pedestrians. In 1987 in Metro Toronto, there were 102 deaths involving motor vehicles, and 21,826 accidents causing physical injury to one or more persons.

IMPACT ON THE ENVIRONMENT While acid rain and other effects of airborne pollutants are of great environmental concern, the "greenhouse effect" is potentially the most serious environmental consequence of automobiles. This term refers to the observed fact that certain naturally occurring gases in the atmosphere, notably water vapour, carbon dioxide, ozone, and methane - trap heat radiated by the earth and cause the climate to be about 33°C warmer on average than it would be otherwise. An increase in this naturally occurring greenhouse effect could have serious consequences on forest, coastal and other ecosystems, as well as on agriculture and human life. ¶ The greenhouse effect has been strengthened by emissions of human activities. Carbon dioxide is responsible for about 60% of the strengthening so far. Canada ranks 9th in the world in absolute emissions of carbon dioxide, but third on a per capita basis. We contribute 2% of global carbon dioxide emissions. ¶ Emissions related to transportation account for from 30 to 40% of the total CO_2 emissions in Ontario. Of this, about 60% is from gasoline-powered vehicles. ¶ A 0.5°C global mean warming has already occurred. Conservative estimates indicate that, under business-as-usual scenarios, the global climate will rise 2-5°C above pre-industrial temperatures by the end of the next century. To stabilize concentrations of CO_2, nitrous oxides and CFCs at today's levels requires reductions of over 60% in emissions from human activities.

A STRATEGY FOR REDUCING AUTOMOBILES AND EMISSIONS The transportation strategy discussed in this report consists of a package of interdependent measures which need to be applied over the short and long-term. Action will need to take place at several levels of government. While the City can act on certain aspects, it does not have jurisdiction over the public transit system, emission and fuel efficiency standards, air quality criteria or many roads within its boundaries. However, the recommendations in this report emphasize steps which the City can itself take, as well as the areas where the City can encourage change at other levels of government. ¶ This report sets forth seven targets specific to the transportation sector in Toronto. These targets can be used to assess the effectiveness of the proposed strategy in achieving Council's goals: **GOAL A** *To reduce the level of carbon dioxide (CO_2) emissions from motor vehicles in the city of Toronto.* **TARGET** *1* - A 20% reduction (from 1988 levels) in CO_2 emissions from motor vehicles in the city of Toronto by the year 2005. **TARGET** *2* - A 50% reduction (from 1988 levels) in CO_2 emissions from motor vehicles in the city of Toronto as soon as possible after the year 2005. **GOAL B** *To reduce the levels of carbon monoxide (CO), **nitrogen oxides** (NOx) and hydrocarbon (mostly volatile organic compounds or VOC) emissions from motor vehicles in the city of Toronto.* **TARGET** *3* - A 50% reduction (from 1990 levels) in CO emissions from motor vehicles in the city of Toronto by the year 1995 or sooner. **TARGET** *4* - An 80% reduction (from 1990 levels) in NOx emissions from motor vehicles in the city of Toronto by 2005 or sooner. **TARGET** *5* - A 50% reduction (from 1990 levels) in hydrocarbon emissions from motor vehicles in the city of Toronto by the year 2005 or sooner. **GOAL C** *To minimize the volume of traffic and its effect on quality of life* **TARGET** *6* - A 15% reduction (from the 1986 level) in the proportion of daily trips into the central area made by automobiles by 2005. **TARGET** *7* - A voluntary reduction in personal car use by 20% by residents of the City of Toronto. ¶ To achieve the seven targets listed above, the Technical Workgroup has developed a strategy to: - **Enhance public transit on city streets:** by introducing transit priority initiatives such as clearways and streetcar traffic light priority systems; by increasing restrictions for on-street parking and stopping; by restricting left turns on streetcar priority routes and right turns on bus priority routes. - **Promote use of the bicycle:** by creating bike paths, bike parking, on-street bike lanes, wider curb lanes, a network of safe bike routes through the city and some street closures on Sundays; encouraging bike-to-work programs and bike-to-transit trips. - **Facilitate walking by addressing the needs of pedestrians:** by improving crosswalk systems; creating wider sidewalks; removing obstacles to pedestrians, including service vehicles; maintaining sidewalks for safety; improving streetscapes and lighting; providing weather protection, sheltered walkways, benches, pedestrian sidewalk ramps at intersections to make the sidewalks accessible for all persons; extending the underground pedestrian mall network. - **Limit vehicle emissions:** by enforcing emission standards; raising vehicle emission standards where appropriate; strengthening fuel economy standards; requiring regular car testing; promoting use of alternative fuels; improving traffic flow; restricting idling. - **Expand the rapid transit system:** by improving surface systems; creating a rapid region-wide rail network between the suburbs and city centre; integrating all public transportation services in terms of transfer points and planning; enhancing parking facilities at suburban and Metro rail stations; expanding GO services; extending rapid transit into the Greater Toronto Area. - **Change land use in the city:** by increasing the supply of central area housing; intensifying housing at the Metro and regional levels; discouraging road expansion projects; greening the streets; evaluating the possibility of decommissioning the Gardiner Expressway. - **Develop a public education campaign to reduce automobile use:** by encouraging workplace incentives such as ridesharing, flexible work hours and work-at-home policies; subsidizing public transit use; providing bike parking, showers and lockers to encourage cycling to work; hiring Employee Transportation Coordinators in companies to develop employee car-reduction schemes; encouraging walking and improving pedestrian safety; using City Hall as a model employer; implementing a car-free day in the city; encouraging households to decrease their overall use of automobiles. ¶ Improvements to public transit are necessary to shift many car drivers to other modes of travel, since future technological improvements to motor vehicles and better emission standards will not be sufficient to improve the quality of the air in the Greater Toronto Area given its expanding population. In the long term, this strategy requires a substantial investment in the public transit system together with a plan to integrate and coordinate existing services. ¶ At the same time, major reductions in emission rates and improvements in the fuel economy of motor vehicles are also needed to help achieve environmental and health goals. ¶ In order for all these strategies to have their full impact, people, supported by social and government policies, must make changes in their personal behaviour and lifestyles. ¶ Finally, in the very long-term, if we are to build a city in which public transit functions efficiently, in which our streets favour a balance of transportation modes and in which the quality of the air is healthy no matter how many people live and work in the city, the City planning process must support these goals. **IMPLICATIONS AND FUTURE DIRECTIONS** To ensure continued action on the issues in this report, the Technical Workgroup proposes the following measures: (i) public consultation - to discuss further the proposals with the community, businesses and other levels of government. (ii) follow-up - to monitor the achievement of the recommendations in the report. (iii) coordination - among Metro and city policies and initiatives to ensure recommendations can work properly. (iv) ongoing public education and input - to ensure organizational and behavioral changes to achieve the report's goals and objectives. ¶ The recommendations listed below were developed specifically to implement the Transportation Strategy outlined in this report. Some are for the City of Toronto, others for other levels of government, the private sector and the public. ¶ Taken together, over time, they can achieve the goals set out in the introduction of this report, to reduce air pollution from vehicles and reduce the total volume of vehicles on city streets. In doing so, Toronto will be joining a growing number of cities throughout Europe, North America and Asia which are implementing strategies to control automobile use and its detrimental consequences on city life.

Residential and office development should be concentrated in areas that are already built-up and served by public transit.

The alternative—low-density, automobile-dependent neighbourhoods, industrial complexes, and office parks—will only lead to increased traffic tie-ups, as more and more commuters drive into the City from the suburbs. Urban sprawl also gobbles up prime farmland.



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TRANSIT FIRST

Rush Hour Measures:

1. That the City of Toronto and the Municipality of Metropolitan Toronto establish a complete grid of surface transit priority lanes on major roads in the City of Toronto to ensure speedy access to all points in the city. This system should include the following:

1a. That the City of Toronto, in conjunction with the Municipality of Metropolitan Toronto, prohibit driving on streetcar tracks in both directions during rush hours. The only exceptions would be for emergency vehicles and at the approach to selected intersections so as to facilitate turning movements.

1b. That the City of Toronto, in conjunction with the Municipality of Metropolitan Toronto, prohibit driving in bus priority lanes in both directions during rush hours. The only exceptions would be for emergency vehicles, bicycles, at the approach to selected intersections so as to facilitate turning movements, and taxis where appropriate.

1c. That the City of Toronto, in conjunction with the Municipality of Metro Toronto, totally prohibit curbside parking or stopping on all major transit routes in both directions during rush hours. The prohibition would take effect one half hour before rush hour on these routes to permit removal (towing) of violators.

1d. That the City of Toronto, in conjunction with the Municipality of Metropolitan Toronto, prohibit left turning movements on the streetcar priority routes at all except a very limited number of intersections, and prohibit right turning movements on bus priority routes where such movements would delay bus flow. Appropriate measures should be taken to ensure that residential streets are not adversely affected.

2. That the City of Toronto request that the Municipality of Metropolitan Toronto implement a streetcar traffic light priority system for public transit vehicles.

3. That the City of Toronto request that the Metropolitan Toronto Police Force increase enforcement of driving, parking and stopping restrictions on new transit priority routes.

4. That the City of Toronto request that the Municipality of Metropolitan Toronto and the other area municipalities undertake similar transit facilitation measures on their major roads.

5. That the City of Toronto urge the TTC to allow loading and unloading of passengers at the front and middle doors of streetcars and buses to encourage faster loading and unloading. This system is currently being tested on the Queen streetcar route.
6. That the City of Toronto request that the TTC assess a system-wide transfer system in which TTC patrons could break travel trips as many times as desired within, for example, one hour of paying a fare.
7. That the City of Toronto request the TTC to assess the feasibility of direct streetcar routes destined for the Central Area, along existing tracks, similar to the "downtowner" that had been tried in the late 1970's/early 1980's. The purpose of these would be to alleviate congestion on the Yonge Street subway and to minimize the number of physical transfers required of transit patrons.

Non Rush Hour Measures:

8. That the City of Toronto, in conjunction with the Municipality of Metropolitan Toronto implement recommendations 2, 5 and 6 around the clock.

MAKING TORONTO'S TRANSPORTATION SYSTEM AVAILABLE TO ALL

9. That the City of Toronto continue to encourage the ongoing efforts of the TTC to provide an equal level of service to groups with special needs.
10. That the City of Toronto encourage the TTC to enhance its current public consultation process to formally involve citizens and community groups in assessing priorities and service needs.

ROADS FOR CYCLISTS TOO

11. That the City of Toronto adopt as a high priority the development of a network of on-street bike lanes.
12. That the City of Toronto support programs which aggressively promote bike commuting to work and school, such as the City Cycling Committee's Bike-To-Work Program, and that Metro be encouraged to do the same.
13. That the City of Toronto and the Municipality of Metropolitan Toronto jointly sponsor a pilot project in 1991 in which certain streets would be closed to cars on Sundays to provide safe opportunities for non-polluting recreation and travel in the city.

SPACES FOR PEDESTRIANS

14. That the City of Toronto investigate the potential for restricting on street truck loading in areas with heavy pedestrian traffic to off-peak hours.
15. That the City of Toronto allocate the resources necessary to clear snow and ice from all sidewalks in the city after the 12 hour period following a snow storm is over and charge building owners for costs.
16. That the City of Toronto ensure that the curbs at all street corners and pedestrian crosswalks are cleared of snow immediately following snow clearing on streets and encourage Metro to do the same on Metro roads.
17. That the City of Toronto ensure that public safety and access considerations be incorporated into the design of physical spaces for pedestrians, particularly in the areas of subway accesses, street lighting, underground tunnels and underpasses and sidewalks.
18. That the Technical Workgroup on Traffic Calming and Vehicle Emission Reduction, through the Healthy City Office, report to City Council on the ways in which pedestrian issues are currently handled, and investigate and recommend strategies for heightening awareness and facilitating action on these issues.

IMPLICATIONS FOR TRAFFIC

19. That the City of Toronto recognize the need to reduce vehicle kilometres travelled in the city of Toronto by the year 2005 to the extent necessary to achieve the emission targets outlined above and to avoid an increase in congestion on the remaining road space available to automobiles, which could potentially offset emission reduction gains.

EXPANDING THE RAPID TRANSIT SYSTEM

COORDINATING TRANSIT

20. That the City of Toronto urge the Ontario Ministry of Transportation, as part of its mandate, to internally undertake the responsibilities suggested for the proposed Inter-regional Transit Coordinating Agency outlined in the recommendations of the Transit Advisory Group report.

21. That the City of Toronto fully support the Ontario Ministry of Transportation in pursuing the objectives outlined in recommendation #1 of the 1988 report of the Transit Advisory Group.
22. That the City of Toronto request that GO and TTC investigate the potential for further physical integration of transit services at all GO rail stations within Metropolitan Toronto.
23. That the City of Toronto encourage the TTC and GO Transit to provide secure, covered bike parking at all subway and GO stations, convenient routes to and from stations, and to aggressively promote combined bike transit trips.
24. That the City of Toronto fund a pilot project in conjunction with the TTC to demonstrate the potential of bike-and-ride trips.

EXPANDING GO SERVICE

25. That the City of Toronto support the long term goal of utilizing many, if not all, of the rail corridors in the Municipality of Metropolitan Toronto for rapid transit use in accordance with GO Transit's long term service strategy.
26. That the City of Toronto urge the Ontario Ministry of Transportation to undertake freight rationalization network studies within the Greater Toronto Area in conjunction with CN and CP Rail.

EXTENDING RAPID TRANSIT: A PROPOSAL

27. That the City of Toronto urge the Province of Ontario to increase spending on rapid transit to enable significant, comprehensive expansion of the rapid transit system in the Greater Toronto Area as soon as possible.

FINANCING PUBLIC TRANSIT EXPANSION

28. That the City of Toronto urge the Government of Ontario to take immediate measures to protect potential rapid transit corridors in the GTA while the necessary capital funds are being raised. This can minimize the eventual costs of expanding the rapid transit infrastructure.
29. That the City of Toronto request that Government of Ontario investigate a system whereby revenue generated

by the various options under consideration by Metro, and/or a carbon tax, can be dedicated to transit subsidies.

30. That the City of Toronto and the Provincial government investigate a new formula for taxing gasoline which will tie the tax rate to the Corporate Average Fuel Economy (CAFE).
31. That the City of Toronto urge the Governments of Canada and Ontario to each use their existing regulatory powers to establish a carbon release surcharge fund as soon as possible and that these monies be dedicated towards transportation alternatives to the automobile, including public transit.
32. That the City of Toronto request the Federal Government to investigate the structure and administration of a manufacturing tax designed to incorporate the cost of environmental damage into the price of fuel.

LIMITING VEHICLE EMISSIONS

RAISING EMISSION STANDARDS

33. That City of Toronto indicate to the Government of Canada that it fully endorses the adoption of the California standards for automobile emissions by 1994.
34. That the City of Toronto urge the Government of Ontario to allow the retro-fitting of older cars which seek to improve fuel efficiency and decrease emission levels.

TESTING VEHICLE EMISSION

35. That the City of Toronto urge the Government of Ontario to systematically enforce the current emission standards, and that penalties imposed be strict enough to encourage compliance.
36. That the City of Toronto reiterate to the Province of Ontario its interest in the commercial development of mobile detectors capable of measuring pollutant emissions from automobiles, and its willingness to assist the province in the establishment of a network of such detectors to the extent that it includes roads controlled by the City of Toronto.
37. That the City of Toronto urge the Province of Ontario to require periodic emission testing of all road vehicles in conjunction with annual license renewal.

STRENGTHENING FUEL ECONOMY STANDARDS

38. That the City of Toronto use every opportunity to urge the Provincial and Federal levels of government to:
    - (a) implement a transition from the present CAFE standard of 27.5 mpg to 50 mpg (4.6 litres/100 km) by the year 2000;
    - (b) develop and implement standards for efficiency improvements among light and heavy duty trucks as high as is technically achievable;
    - (c) impose a revenue-neutral system of sliding surcharges and rebates designed to encourage consumers to purchase the most energy-efficient automobiles and to discourage purchase of light-duty trucks in place of automobiles for private use.

USING ALTERNATE FUELS

39. That the City of Toronto support further research and development efforts in the area of alternative fuels.

MANAGING TRAFFIC INCLUDING ROAD PRICING AND IDLING

40. That the City of Toronto bring forward a by-law to restrict unnecessary idling.
41. That the City of Toronto and the Municipality of Metro Toronto jointly fund a study of road pricing to determine the best model for Toronto, as a possible long term option.

PLANNING FOR FEWER CARS

42. That the City of Toronto increase the supply of Central Area housing, to reduce the need for inbound commuting. Such initiatives should include:
    - (a) the intensification of residential development along major city streets served by transit, as provided by the Housing on Main Streets Program;
    - (b) the development of new residential areas such as Ataratiri, the Massey lands and the Bathurst/Spadina neighbourhood;
    - (c) appropriate redevelopment and infilling in existing residential areas; and
    - (d) relating the production of office space to the building of new residential units in the central area.

43. That the City of Toronto encourage similar land-use intensification strategies at the Metro and regional levels, to discourage further urban sprawl and auto-dependency.
44. That the City of Toronto discourage road expansion projects which would increase automobile commuting into the city.
45. That the City of Toronto examine the feasibility of requiring that transportation demand management plans be developed in existing non-residential developments with over 75 parking spaces.

PARKING FOR AUTOMOBILES

46. That the City of Toronto encourage employers to eliminate or reduce parking subsidies provided to employees.
47. That Toronto City Council show leadership in this area by replacing subsidized parking for Councillors and employees with incentives for taking transit, walking or cycling.
48. That the City of Toronto urge the Governments of Canada and Ontario to reduce or eliminate all corporate automobile related tax deductions for employees who do not use their car for work-related purposes.
49. That the City of Toronto urge the Government of Ontario to apply the Commercial Concentration Tax in cases where parking is provided free of charge, particularly in the Central Area.
50. That the City of Toronto request that the Metropolitan Toronto Police Force increase its enforcement of the three-hour daytime parking restrictions in residential areas for non-permit holders.
51. That the City of Toronto request TTC and GO Transit to provide preferred parking; that is, parking spaces closest to the station, to vehicles carrying two or more passengers, in at least 10% of the parking spaces in all their stations with parking facilities.

PARKING FOR BICYCLES

52. That the City of Toronto adopt new zoning by-laws which would require all new major developments to provide secure bike parking and shower/change facilities for bike commuters.
53. That the City of Toronto encourage and offer incentives for existing developments to provide secure bike parking facilities to meet the demand.

54. That the City of Toronto expand the bike rack program from the current level of 175 post-and-ring stands per year to 1,000 per year for the next five years. This will enable the City to meet the growing demand from cyclists and merchants and to ensure that racks are installed in all new or reconstructed sidewalks and at all City-owned properties.
55. That the City of Toronto, through the Planning and Development Department, and the Toronto Parking Authority develop a program to provide bike parking facilities at appropriate locations.

DECOMMISSIONING THE GARDINER EXPRESSWAY

56. That the City of Toronto urge the Municipality of Metro Toronto and the Province of Ontario (Ministry of Transportation) to examine the economic and transportation impacts of decommissioning the Gardiner Expressway.
57. That the City of Toronto urge GO Transit and the Government of Ontario (Ministry of Transportation) to assess the train service - and related incremental rail plant infra-structure needs - necessary to accommodate the additional traffic as a result of the potential decommissioning of the Gardiner Expressway.
58. That the City of Toronto urge the Government of Ontario (Ministry of Transportation) to consider the immediate implementation of HOV lanes on the Gardiner Expressway during rush hour, as an interim measure.

BREAKING THE CAR HABIT

WORKPLACE INCENTIVES TO REDUCE AUTOMOBILE USE

59. That the City of Toronto encourage all Toronto employers with over 100 employees in the city to develop trip reduction plans, including details on how the use of alternatives to automobiles will be supported and facilitated by the employer.
60. That the City of Toronto develop such a plan for its own employees, to be used as a model for other employers.
61. That the City of Toronto approve, in principle, the hiring of an Employee Transportation Coordinator to develop the model plan, and to work with employers to encourage workplace changes.

62. That the City of Toronto urge the Federal government to 1) make corporate benefits for non-work-related automobile use a source of taxable income, and 2) allow tax deductions for public transit related benefits.

63. That the City of Toronto promote the use of bikes among City employees by:
    i) providing more and better bike parking and clothing lockers for City employees who cycle to work;
    ii) paying City employees the same mileage for using bicycles as for using cars for work-related trips;
    iii) providing and maintaining a fleet of bicycles for use by City employees for work-related trips; and
    iv) offering cycling skills courses for City employees through the Employee Learning Opportunities Program.

64. That the City of Toronto encourage other employers, including Metro government, to provide the same facilities as mentioned above.

65. That the City of Toronto request the Federal and Provincial governments to provide tax deductions for employer purchased ridesharing vehicles and bicycles as well as incentives to hire employee transportation coordinators.

66. That the City of Toronto, through the Healthy City Office, work with the Ministries of Transportation and Energy to develop a promotional campaign directed at city of Toronto employers, to encourage the establishment of employee transportation centres which match partners for ridesharing, public transit, cycling and walking.

67. That the City of Toronto request that the Ontario Ministry of Transportation expand its current ridesharing matching software (SARRMS) to include matching partners for walking, cycling and taking public transit.

68. That the City of Toronto request the Ontario Ministry of Transportation to initiate an area-wide ridesharing program along specified highways for the Greater Toronto Area, including high occupancy vehicle (HOV) lanes for buses and cars with two or more people.

DEVELOPING A PUBLIC EDUCATION CAMPAIGN

69. That the City of Toronto, through the Healthy City Office and Information and Communication Services Division of the Department of the City Clerk, prepare a communication strategy and budget to encourage transportation alternatives to car use in the City of Toronto, in consultation with the Public Education Subcommittee of the Technical Workgroup.

70. That the Healthy City Office, through the Committee of Heads, bring forward the transportation alternatives plan for employees as outlined in this report.

71. That the City of Toronto request the Ministries of Transportation, Energy and Environment, as well as GO, TTC and the Parking Authority to cost share a study of drivers in the city to determine the best approaches for public education.

72. That the City of Toronto endorse a voluntary City Hall Car Free Week and establish a committee to implement a three-year program leading to a full city-wide car free week in 1993.

IMPLICATIONS AND FUTURE DIRECTIONS

73. That the Healthy City Office, in conjunction with the Technical Workgroup on Traffic Calming and Vehicle Emission Reduction, undertake a series of consultations with a range of groups, organizations and businesses in the community on this report and report back to City Council in 6 months.

74. That the City of Toronto direct the appropriate City departments to report on how they can implement the recommendations and achieve the targets outlined in this report.

FOREWARD

GENESIS OF THIS REPORT

As a result of the 1988 Changing Atmosphere Conference on Global Warming and the subsequent 1989 report by the Special Advisory Committee on the Environment, Toronto City Council adopted the motion to reduce carbon dioxide (CO_2) emissions by 20% from the 1988 level by the year 2005. In addition, on October 4 and 6, 1989, the Board of Health held a special meeting on the "War on Pollution from Automobiles, Trucks and Buses" to hear from individuals and community groups about the increase in air pollution and traffic problems in the city.

On October 19/20 1989, City Council approved the Report of the Medical Officer of Health which recommended the establishment of a technical workgroup to:

i) prepare a long-term strategy to reduce traffic and vehicle emissions in the city, and
ii) assess the feasibility of "traffic calming" (the reduction of traffic volume and traffic speed) and emission reduction measures for Toronto.

The Technical Workgroup was established in February 1989 to achieve the above objectives. The Workgroup has representation from municipal government, business, environmental groups, and ratepayers (Appendix 1 lists group membership and Appendix 2 the terms of reference of the Workgroup). The Healthy City Office chaired the committee and coordinated the writing of this report.

The workgroup represents a diverse range of interests and responsibilities. As with any such group, there has not been complete agreement with every issue that came under discussion. The conclusions and recommendations of the report represent a consensus, although not every member of the workgroup agrees with all points made in the report. Nonetheless, the workgroup unanimously agreed that the report as written is a good starting point for action and public debate and should go forward as soon as possible.

The goal of this document is to assist City Council in developing a strategy to achieve a more liveable city through the reduction of traffic and air pollution. In this report, the committee has brought forward a broad range of proposals to reduce the negative health, social and environmental impacts of motor vehicles. Some can be implemented immediately while others must be phased in over the longer term.

Broad consultation is necessary to achieve consensus on the directions needed regarding the automobile in our city. Therefore, while this document has already had input from a variety of people and groups, it is important that it be used as a basis for ongoing discussions and monitoring as its recommendations are implemented.

The primary focus of this report is on automobiles and the movement of people in the city, since private cars and taxis comprise the largest proportion of vehicle trips into Metro Toronto. In fact, eighty-four percent of all inbound vehicle trips across the Metro cordon, during the morning peak period, are made by cars compared to 12% by trucks (Municipality of Metropolitan Toronto, 1990). Across the central area cordon, the proportion of cars and trucks are 85% and 14% respectively. Therefore, we have not specifically discussed commercial vehicles in this report. Buses and trucks, however, could be affected by certain proposals concerning emission standards, idling, road use and fleet management. On the other hand, to the extent that the recommendations result in fewer private cars on the roads, commercial vehicles may be advantaged. Specific comment on this report will be sought from businesses, utility and delivery companies, taxi companies and others.

The Healthy City Office and the Technical Workgroup on Traffic Calming and Vehicle Emission Reduction will monitor follow-up on the recommendations in this report.

THE HEALTHY CITY INITIATIVE

The Healthy City Project was established by City Council in 1989 to work with various sectors in the community to:

(i) improve and maintain the quality of life in the city;
(ii) create a physical environment that supports the health of citizens;
(iii) reduce inequalities in opportunities to achieve health in its broadest sense;
(iv) encourage lifestyles that sustain the environment.

The preparation of this report is a natural outgrowth of the Healthy City Project's mandate, as traffic and vehicle emission reduction are important components in a strategy to make the city more liveable.

The issues of traffic and pollution must be addressed in the context of two questions: What kind of city do we want and, how do we want to live in that city? Motor vehicles, while bringing certain benefits, have also adversely affected the quality of life in our downtown area and neighbourhoods. As Toronto continues to expand, it is essential that there be an integrated transportation system to help manage growth and avoid the enormous problems occurring in other large cities.

Toronto is fortunate in that it has a strong history of integrating land use planning and transit to minimize automobile dependence. In fact, Toronto is a model for other cities in this regard (Kenworthy, unpublished paper, 1989). Nonetheless, declining investment in the rapid transit system after the early 1960's coupled with rapid growth in the downtown and areas in and around Metro Toronto, have resulted in increased car use and more traffic and vehicle pollution. As well, transit service and capacity are not as high as necessary to cope with growing demands. Projected growth for the Greater Toronto Area suggests that congestion and pollution problems will worsen without active intervention.

The time to plan is now. The purpose of the strategy outlined in this report is to provide an overview of actions needed to move Toronto on a course to reduce the negative impact of the automobile on life in the City. In doing so, Toronto will be joining a growing number of cities throughout Europe, North America and Asia which are implementing strategies to control automobile use and its consequences.

PRINCIPLES FOR A MUNICIPAL TRANSPORTATION STRATEGY

The strategies outlined in this report are aimed at achieving the following goals:

i) reduction of air pollution from vehicles,

ii) reduction of the total volume of vehicles on city streets.

In assessing the various options for a transportation strategy, the committee was guided by the following principles:

1. Sustainability

- All transportation policies must be sensitive to the natural environment.
- Use of non-renewable natural resources such as fossil fuels for transportation should be minimized so that the resource consumption of future generations is not unfairly restricted by today's decisions.
- Land use, urban design and planning policies should minimize urban sprawl, the encroachment on rural and agricultural lands, and commuting distances.

2. Coordination and Integration

- Better coordination among governments involved in transportation planning and management is crucial to the success of an efficient transportation system.
- Transportation policies and programs across the Greater Toronto Area (GTA) should be easily understood by the public and should consistently address the need to reduce vehicle use and encourage other ways of travelling.
- Public transit services should facilitate equal access and provide more efficient service to all members of the community.

3. Quality of Life

- Transportation policies should maximize the quality of life for Torontonians, by enhancing greenspace, cycling and walking; decreasing the negative effects of cars; ensuring the safety and security of all people; and facilitating mobility.

4. Social Equity

- Policies and programs should not favour one segment of the population over another.
- All persons, irrespective of their socio-economic status, race, gender or abilities, should have access to an equal standard of transportation service. The transportation system should ensure that sufficient components are in place to meet the needs of all persons.

5. Community Involvement

- Transportation planning and management should include specific mechanisms for public input, feedback and evaluation.
- Community groups should be supported in assessing the need for specific transportation services.

1. COST OF THE CAR: CAN WE AFFORD IT?

Since the first mass-produced car rolled off the assembly line in the early 1900's, the automobile has radically altered both our mobility and our land-use patterns. While the automobile has brought comfort, convenience and privacy to transportation, it has profoundly affected urban living in the developed world. One consequence is to enable people to commute to and from areas where land and housing prices are lower. With the birth of suburbs and sprawling urban centres during the 1950's and 1960's, cars became a necessity of everyday life in North America. Workplaces, housing and shopping were located in areas often accessible only by car. The annual world car production is now at 33 million, a 400% increase since 1950. Eighty-one percent of these cars are purchased in the developed world (Renner, 1988).

Motor vehicles have a major impact on the quality of life in urban areas (Greenpeace UK, 1991; Mackenzie and Walsh, 1990; Ecoplan International, 1990; Roberts, 1989). While we enjoy the convenience of the automobile, it is the least energy efficient form of transportation, the most polluting, and requires the most road space on a per capita basis (See Exhibit 1). In addition, traffic emissions contribute significantly to poor health (respiratory infections, cancer), environmental degradation (decreased agricultural productivity, acidification of lakes and rivers, smog), enhancement of the greenhouse effect (global warming), noise pollution and the depletion of non-renewable resources. Traffic congestion contributes to the frustrations and stress of urban living as well as pollution and inefficient fuel use.

The following facts illustrate the growing impact of the automobile on quality of life in terms of pollution and congestion in the Toronto area:

EXHIBIT 1

A COMPARISON OF ENERGY USE AND CARBON DIOXIDE EMISSIONS BY TRANSPORTATION MODE

Transportation Mode	Fuel or electricity use	Number of Commuters	Energy Use (MJ/person-km)	CO_2 Emission (gm C/person-km)	CO_2 Emission (gm C/person-km)*
Gasoline Powered Vehicles					
Auto	15 Litres/100 km	1	4.74	101	(71-82)
		6	0.79	17	(12-14)
	10 L/100 km	1	3.16	67	(7-54)
		4	0.79	17	(12-14)
	7 L/100 km	1	2.21	47	(33-38)
		4	0.55	12	(8.3-9.5)
Van	20 L/100 km	15	0.42	8.9	(6.3-7.2)
	10 L/100 km	7	0.45	9.6	(6.7-7.7)
Electric Vehicles					
Auto	150 km/30 kWh	1	0.72	59	(17)
		4	0.18	15	(4.3)
Van	90 km/30 kWh	6	0.14	12	(3.4)
Public Transit Vehicles					
Diesel Bus	56 L/100 km	40	0.52	11	(7.7-8.5)
Trolley Bus	2.66 kWh/km	40	0.24	20	(5.8)
Streetcar	3.02 kWh/km	46 (per car)	0.24	20	(5.8)
Subway	2.61 kWh/km	75 (per car)	0.13	11	(3.1)
GO Rail	761 L/100 km	810	0.35	7.5	

*Natural gas is substituted for gasoline or diesel, or in the case of electric vehicles, natural gas powers the generation of electricity

Source: City of Toronto 1991

- In the City of Toronto, emissions from vehicles comprise the largest source of urban air pollutants (City of Toronto, 1988a).
- In 1990 it is estimated that 16.5 kilotonnes of CO_2 (carbon dioxide), 63 tonnes of NO_X (nitrogen oxides), and 103 tonnes of VOC (volatile organic compounds), were emitted every day from motor vehicles in the GTA (Friends of the Earth, 1990).
- If present population and consumer trends continue, vehicle ownership and road traffic in Metro will double over the next 35 years.
- The average car now carries from 2 to 7% fewer people than 15 years ago (Ontario Ministry of Transportation, 1988).
- Over time, vehicle trips across the Metro boundary have been distributed over longer morning and afternoon time periods and midday travel is increasing, resulting in more traffic over the whole day (Municipality of Metropolitan Toronto, 1990).
- Over 700,000 person trips are made into and within Planning District 1 (roughly the Central Area) every day. Forty-four percent are made by automobile (Ontario Ministry of Transportation, 1989).
- Seventy three percent of automobile trips into Planning District 1 daily are made by drivers who live in Metro Toronto. Twenty five thousand automobile trips per day in Metro are made by city residents alone (Ontario Ministry of Transportation, 1990).
- Fifty-two percent of morning peak period trips which begin and end within Metro are made by car.
- Trips by automobile into the central and downtown areas are respectively 34% and 26% of all person trip crossings during the morning peak period (Municipality of Metropolitan Toronto, 1990).
- In an international study of 32 cities regarding automobile dependence and gasoline use, Toronto ranked 17th. It was rated as "moderately dependent" (Kenworthy and Newman, 1989).

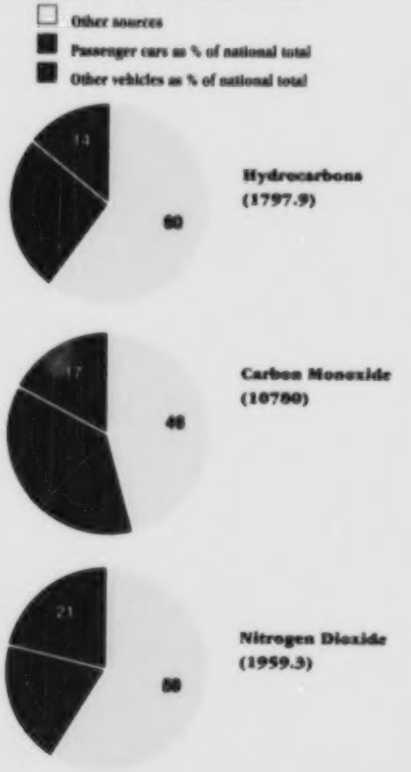
- Eighty-four percent of people crossing the boundary into Metro Toronto from outside Metro during morning rush hour use their cars. These trips represent 19% of all the trips made in Metro at this time (Ontario Ministry of Transportation, 1989).
- The number of vehicles crossing the Metro cordon daily has increased by about 150% since 1975, and the number crossing the downtown cordon rose by 20% (Municipality of Metropolitan Toronto, 1990).
- Over the past 25 years, in the Greater Toronto Area, the number of vehicle trips have increased at twice the rate of the population growth (City of Toronto, 1990).
- The number of car trips per person per day in Metro has close to doubled over the past 30 years (Ontario Ministry of Transportation, 1988).
- The total quantity of pollutants in the air from vehicles (nitrogen oxides, carbon monoxide and hydrocarbons) increased 18% in Toronto from 1982 to 1985 (City of Toronto, 1988a).
- Toronto rated among the highest for nitrogen dioxide and carbon monoxide among international cities in a recent World Health Organization study (United Nations Environment Program (UNEP) and World Health Organization (WHO), 1988).

The overall conclusion from these trends is that automobile use in the GTA, Metro and the City is rising, partly as a result of increasing population in the Greater Toronto Area and partly due to more people driving. While public transit has absorbed a substantial share of passengers, the bottom line in terms of emissions and traffic volume is the number of vehicles on the road.

Appendix 4 presents estimates of future emissions if current trends continue in the Greater Toronto Area, as well as alternative scenarios under various interventions.

EXHIBIT 2

EMISSIONS FROM TRANSPORTATION IN CANADA AS A PERCENTAGE OF THE NATIONAL TOTAL FROM ALL SOURCES (national total in kilotonnes)



Source: Transport Canada and Environment Canada 1989

IMPACT ON INDIVIDUAL HEALTH

There are five major air pollutants present in the exhaust emission of gasoline burning cars: nitrogen oxides (NO_X), carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbons (HC) and suspended particulates (SP). Road vehicles produce about 70% of Toronto's nitrogen oxide pollution, 90% of the carbon monoxide, 75% of total hydrocarbon emissions. In addition, nitrogen oxides and hydrocarbons interact in sunlight to produce a sixth pollutant, ozone. All of these pollutants affect the health of humans and the environment.

Air pollution aggravates coughs and sore throats, hampers breathing in asthmatics, prevents lungs from functioning properly and adversely affects people with cardiovascular and chronic respiratory diseases. Chronic obstructive lung disease - asthma, bronchitis and emphysema are the most significant long-term effects of air pollution. Urban areas have higher rates of deaths from lung cancer and lung diseases than rural areas, which may be due in part to air pollution. Studies in the U.S. show that most of the air toxics cancer risk in urban areas is due to emissions from road vehicles (Federal/Provincial Research and Monitoring Coordinating Committee, 1990).

Other pollutants from vehicles also have health consequences. Diesel vehicles emit particulates at a rate of 50 to 80 times that of their gasoline-fuelled counterparts (Transport Canada and Environment Canada, 1989). As such, the major cause for concern relates to their contribution to lung disease and cancer. On the other hand, they emit a relatively small percentage of other pollutants. Lead in the air and soil is due in part to exhaust from vehicles using leaded gasoline. As of December 1990 leaded gasoline is no longer sold in Canada, but residues will remain in the soil. Lead toxicity affects the central nervous system, kidneys and blood synthesis, especially of young children. Sulphuric acid, in the form of acid rain, produces acid aerosols which have been associated with lung dysfunction, especially in children (Federal/Provincial Research and Monitoring Coordinating Committee, 1990).

Exhibit 2 summarizes the inventory of total hydrocarbons, carbon monoxide, and nitrogen oxides emissions from the transportation sector in Canada.

Car exhaust is Canada's fastest growing pollution threat. Tailpipes emit carbon monoxide, a poison, hydrocarbons, which cause smog, and nitrogen oxides, which cause both smog and Acid Rain. Vehicles also give off carbon dioxide, which is building up in such quantities that it is creating a global warming trend, known as the greenhouse effect.

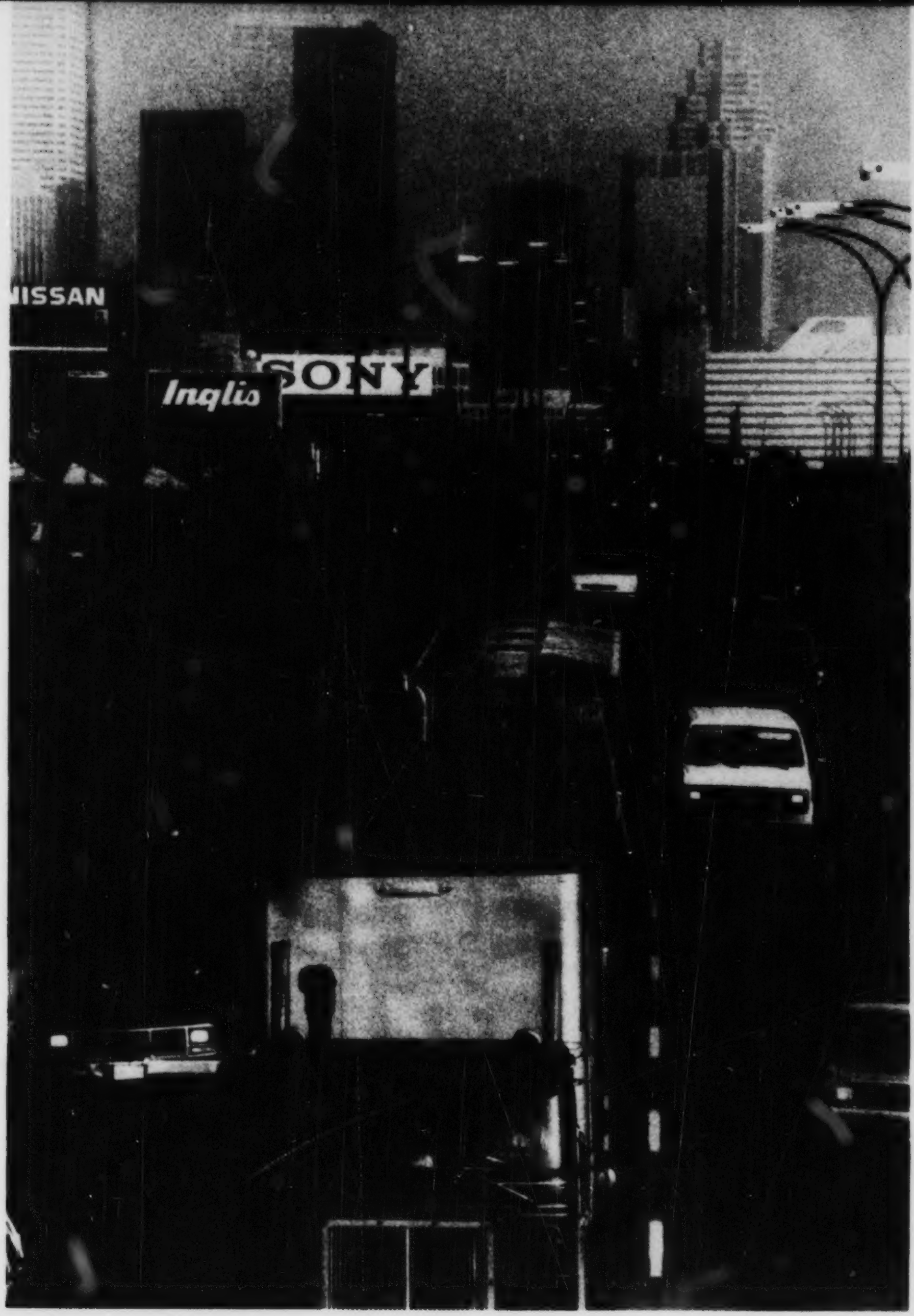


Photo by Vince Pietropaolo.

EXHIBIT 3

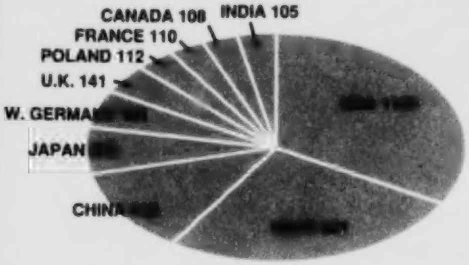
TYPES OF AUTOMOBILE EMISSIONS AND THEIR IMPACT ON INDIVIDUAL HEALTH AND THE ENVIRONMENT

POLLUTANTS FROM AUTOMOBILES	WHAT IT IS	HEALTH IMPACTS	ENVIRONMENTAL IMPACTS
Nitrogen Oxides (NO_x)	Nitric Oxide (NO) is the major NO_x component and oxidizes into nitrogen dioxide (NO_2) in the presence of hydrocarbons and sunlight. Nitrogen dioxide reacts with hydrocarbons to form ozone or with water to form nitrate (NO_3), a significant source of acid rain.	-odour -increasing sensitivity of asthmatics and bronchitis -NO_2 is a lung irritant which can produce pulmonary edema at high concentrations -susceptibility to respiratory infections in young children and the elderly.	-metal corrosion and vegetation damage through acid rain -acid rain accounts for an annual loss of $197 billion in commercial forest wood products and a further $1.3 billion due to recreation and wild life habitat destruction -NO_2 contributes to stratospheric ozone depletion
Carbon Monoxide (CO)	CO is a colourless odourless and tasteless gas which is produced through the incomplete combustion of inorganic materials.	-increased cardiovascular problems in smokers and persons with heart disease -greater susceptibility to respiratory infections in children and elderly	-release of CO_2 into the atmosphere depletes the atmosphere's supply of OH (hydroxyl radical) which is the main natural cleansing agent of the atmosphere. As a result, CO emissions contribute to increases in methane, CFC's and the formation of ozone.
Carbon Dioxide (CO_2)	A gas naturally released by animals and decaying organisms, and absorption and release by the ocean. Until the industrial revolution, this natural cycle had been almost perfectly balanced.		-CO_2 is the most significant greenhouse gas, contributing to global warming.
Hydrocarbons (HC)	Numerous and chemically diverse group of compounds. Non-methane HC, volatile organic compounds (VOC), are important in the formation of ozone	-Benzene, "of substantial carcinogenic concern" (OECD 1986) causes leukaemia in humans -Some hydrocarbons from diesel emissions are carcinogenic	-contributes through the formation of ozone
Ozone (O_3)	Ozone is formed when NO_2 & VOC combine in the presence of sunlight and create a photochemical smog	-decrease in lung function -eye irritation -possible long term role in development of chronic lung disease	-reduced agricultural productivity in crops including soybeans, tomatoes, potatoes and corn -reduced growth rates in trees including red spruce, yellow pine and sugar maple -ozone is a global atmospheric warming agent -estimated loss of between $7-70 million per year to crop growers in Southern Ontario, because of the impact of ozone pollution on agriculture.
Suspended Particulates	Small particles of solid and liquid matter mostly from diesel emissions	-small particles can penetrate lungs & cause respiratory infections -toxic particles can be taken into the bloodstream -effects vary with the type of particulates	-decreased visibility -aesthetic damage to buildings

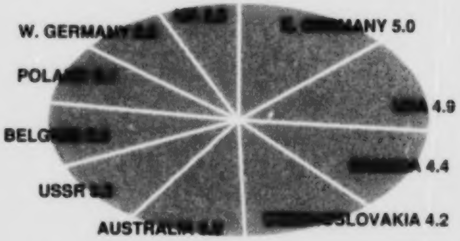
Sources: Bates, D.V. and Sizto, R 1989; City of Toronto 1988; Linzon et al. 1984; Watson, A.Y. et al. 1988

EXHIBIT 4
NATIONS THAT PRODUCE THE MOST FOSSIL FUEL CO_2

Absolute Emissions (million tonnes/year)



Per Capita Emissions (tonnes/year)



Sources: Rotty (1987) for fossil fuel emissions, UN (1990) for population data

Detailed health effects of the above five pollutants and ozone, from fossil fuel burning vehicles are found in Exhibit 3.

Vehicles have other adverse health impacts. The motor vehicle is the major source of accidental fatalities in Metro Toronto, as well as injuries to pedestrians. In 1987 in Metro Toronto, there were 102 deaths involving motor vehicles, and 21,826 accidents causing physical injury to one or more persons (Ontario Ministry of Transportation, 1987). The quality of urban life is also affected by the stress and noise caused by vehicles and traffic congestion.

IMPACT ON THE ENVIRONMENT

This report embraces the concept of an ecosystem approach to investigating and understanding environmental impacts in which humans exist as a component. In the previous section, the human health impacts of vehicle emissions are briefly described. However, these emissions can affect many other components of that ecosystem. Perhaps the most widely studied environmental impacts are global warming and acid precipitation.

Global Warming

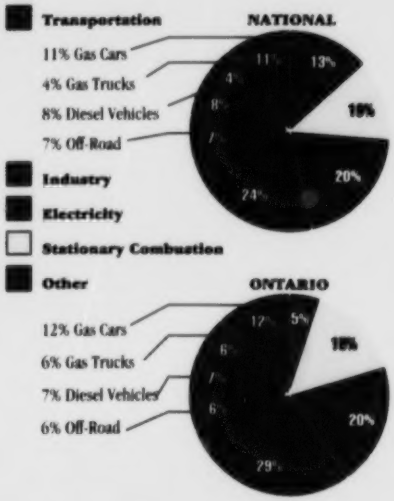
An increase in the greenhouse effect from airborne pollutants is potentially the most serious environmental consequence of automobiles. The term "greenhouse effect" refers to a natural process whereby certain naturally occurring gases in the atmosphere - notably water vapour, carbon dioxide, ozone, and methane - trap heat radiated by the earth and cause the climate to be about 33°C warmer on average than it would be otherwise, thus permitting life to exist on earth.

Carbon dioxide, methane, and ozone are greenhouse gases. Carbon monoxide indirectly contributes to the buildup of methane and ozone, and extends the atmospheric lifetime of the CFC's (chlorofluorcarbons) which, besides leading to depletion of the stratospheric ozone layer, are extremely strong greenhouse gases.

Since the beginning of the industrial revolution, the natural greenhouse effect has been strengthened by the emission of greenhouse gases from human activities. Carbon dioxide (CO_2) is responsible for about 60% of the strengthening of the greenhouse effect so far. Worldwide, about 5.5 billion tonnes of carbon were emitted to the atmosphere in 1990 from the burning of fossil fuels - oil, coal, and natural gas - and another 2-3 billion tonnes from deforestation. Exhibit 4 lists the ten nations with the largest fossil fuel CO_2 emissions in absolute terms and on a per capita basis. Canada ranks 9th in absolute emissions but third on a per capita basis, at 4.4 tonnes carbon per person per year. Canada contributes 2% of global carbon dioxide emissions.

EXHIBIT 5

CARBON DIOXIDE EMISSIONS IN ONTARIO AND CANADA (1987)



Source: Transport Canada and Environment Canada 1989

Exhibit 5 gives the breakdown of CO_2 emissions in Ontario and Canada by source. Direct transportation emissions account for about 30% of the total in Ontario. However, of the industrial emissions in Ontario, about 16% is from petroleum refining and should therefore be credited to the transportation sector, while 33.7% is from iron and steel production, a large portion of which goes into the manufacturing of transportation equipment. This brings the transportation share up to about 40% of total provincial CO_2 emissions, of which about 60% (about 24% of the total) is from gasoline-powered vehicles.

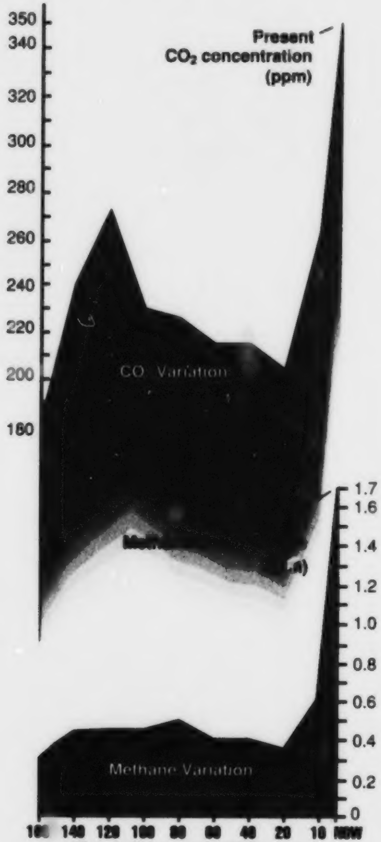
Although natural changes in the composition of the world's atmosphere have occurred in the past, these changes are currently accelerated by human activity. Exhibit 6 illustrates the recent increase in atmospheric carbon dioxide and methane, and the extent to which it is much greater than previous natural variations. Atmospheric carbon dioxide concentrations have increased by 25% since the beginning of the industrial age (Nishi, 1990). The carbon monoxide concentration in the Northern Hemisphere has doubled since the beginning of the industrial revolution (Khalil and Rasmussen, 1988), and the background ozone concentration at ground level in middle and high latitudes in the Northern Hemisphere has also doubled (Hough and Derwent, 1990).

All of these changes will contribute to warming our climate during the coming decades, and are probably important contributing factors to the 0.5°C global mean warming which has already occurred.

Although there is scientific uncertainty concerning the rates and magnitudes of future warming, there is widespread consensus that a warming tendency will occur and that emissions from human activities will

EXHIBIT 6

CARBON DIOXIDE AND METHANE LEVELS OVER THE PAST 200,000 YEARS



Source: Chappalez, J. et al. 1990

enhance natural causes of climatic change. Conservative estimates indicate that, under business-as-usual scenarios, the global climate will have warmed by 2-5°C above pre-industrial temperatures by the end of the next century, making it warmer than at any time during the past 3 to 5 million years. This is illustrated in Exhibit 7. By the year 2025 the global mean climate is likely to have already warmed by 1°C above present values, with increases 2-3 times as large in Canada. Such changes would have damaging consequences on some forest, coastal, and other ecosystems, which cannot adapt with such rapidity, as well as have negative impacts on agriculture in some regions and other human activities.

Stabilizing concentrations of CO_2, nitrous oxide and CFCs at today's levels would require reductions of over 60% in emissions from human activities; stabilizing methane would require a 15-20% reduction (World Meteorological Organization (WMO)/UNEP, 1990). Significant changes in energy use will be required to achieve such decreases.

Acid Rain

As noted in the previous chart, vehicle emissions contain a mixture of many chemical contaminants. Included within this mix are oxides of nitrogen (NOx) which are significant contributors to acid precipitation. Acid precipitation has been directly linked to reduced agricultural productivity, the destruction of some species of trees and plants, the disruption of delicate aquatic systems and the accelerated deterioration of building structures.

It is important to note that the acid precipitation falling on Toronto is largely the result of emissions of NOx and other acid rain contributors that are located up-wind from the city, with a smaller percentage originating locally. However, just as with global warming, our emissions are contributing to a problem that extends beyond our boundaries and are weakening global sustainability.

2. STRATEGY FOR REDUCING AUTOMOBILES & EMISSIONS

The Technical Workgroup has developed a strategy which considers the relationships among different components of the transportation system and their interdependence. The strategy discussed in this report consists of a package of interdependent measures which need to be applied over the short and long-terms to adequately reduce emissions and volume of traffic. Taken together these measures can achieve the following objectives:

-protect the natural and man-made environments;

-maximize accessibility for all people;

-manage congestion and pollution;

-improve the efficiency of public transit operations;

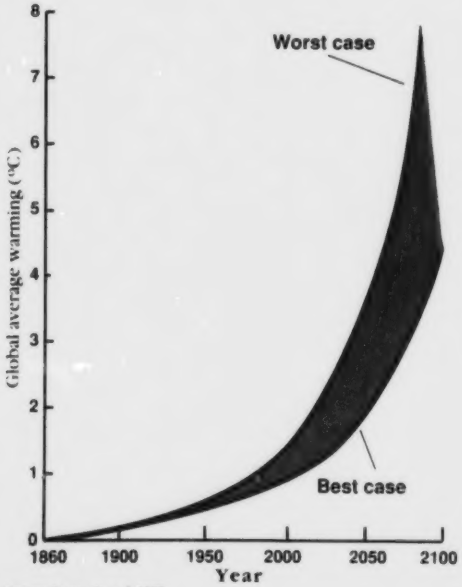
-reduce resource consumption of energy and valuable agricultural land;

-improve human health and quality of urban life.

To achieve these objectives, action will need to take place at several levels of government. While the City can act in certain areas, such as the use of its streets, it does not have jurisdiction over the public transit system, emission and fuel efficiency standards, air quality criteria or many roads within its boundaries. The measures which are recommended in this report emphasize those steps which the City of Toronto can itself take as well as the areas where the City can encourage change at other levels of government.

While the contribution of the city to total emission and traffic volume even within the GTA is limited, the City of Toronto can play a significant role as a leader at the municipal level. Toronto has already taken a strong role in committing itself to a 20% reduction in CO_2 emissions, banning CFCs and prohibiting smoking in public places. This report sets forth seven targets (see Chapter 2) specific to the transportation sector which can be used to assess the effectiveness of the proposed strategy in achieving Council's goals.

EXHIBIT 7
RANGE OF PREDICTED GLOBAL WARMING TO THE YEAR 2100



Source: Crause, F et al. 1989

Three-quarters of all work trips to Toronto's Central Area originate within Metropolitan Toronto, suggesting that many of these trips could be made by public transit, instead of by car.

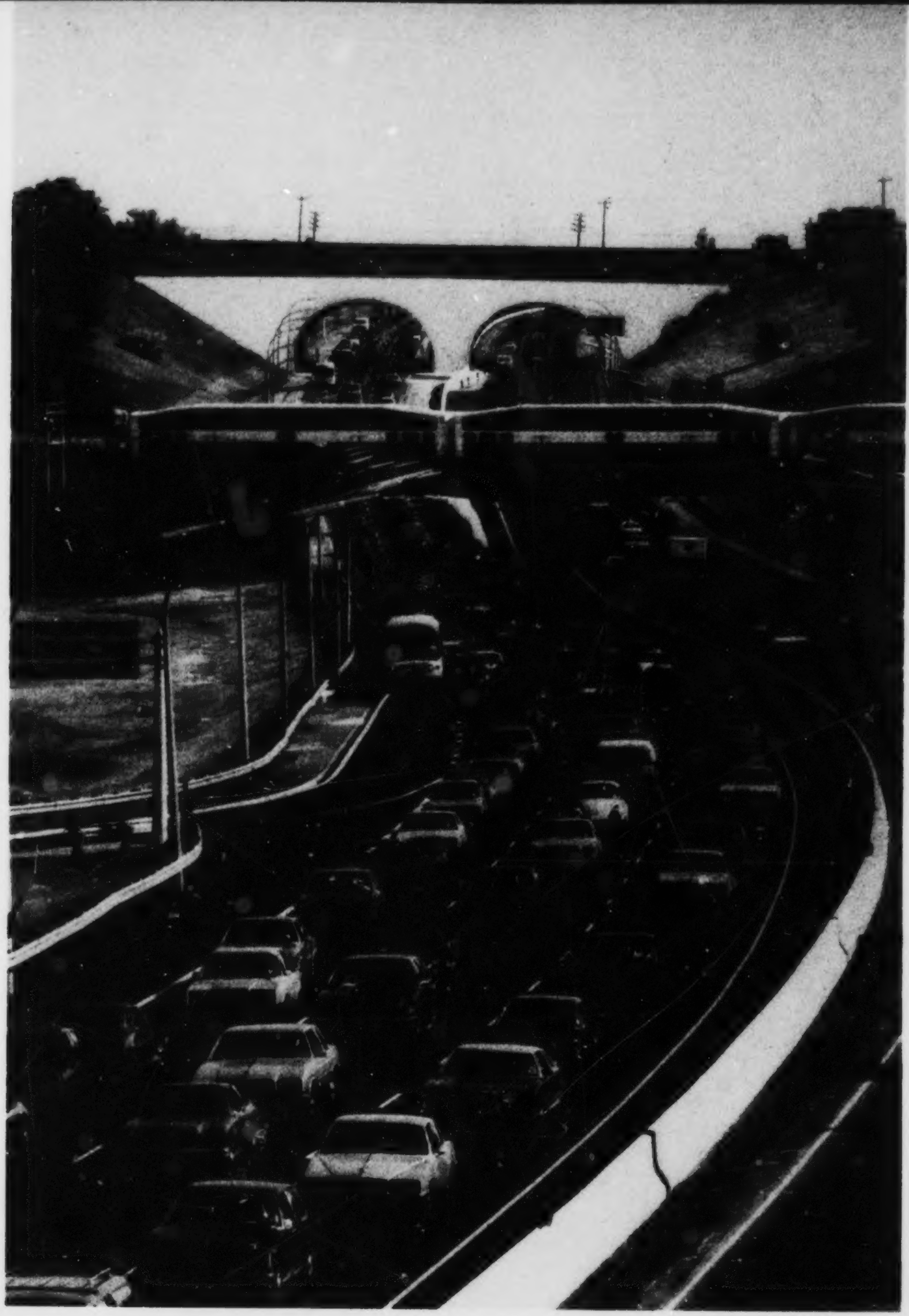


Photo courtesy GO Rail.

One thrust of the strategy which is presented in this report is on the steps which can be taken by the City in the short-term. The City of Toronto should make better use of the existing road space in order to reduce both emissions and the volume of traffic. The issue of automobiles cannot be examined separately from the question of how people move about the city. For a reduction in the volume of cars to take place, there must be a corresponding increase in the use of alternatives such as transit, walking and cycling. Chapter 3 focuses on how the existing streets can be redesigned to enhance non-car uses. This shift is essential because while the proportion of people who use public transit is growing, so is the number of automobiles which are on the road.

Over the next 20 years, the GTA is expected to see significant population growth, which will substantially increase the burden on an already aging rapid transportation system. Chapter 4 outlines the need for a major investment in the public transit system together with a plan to integrate rail services.

While improvements to the on-street and underground public transit infrastructure are intended to induce many car drivers to shift to other modes of travel, a major reduction in emission rates and improvements in the fuel economy of motor vehicles can also help achieve environmental goals. Chapter 5 looks at how the City of Toronto can play an active role in encouraging the adoption of the most stringent emission and fuel economy standards, given current technological capabilities.

In the long-term, if we are to build a city in which public transit functions efficiently, in which our streets favour a balance of transportation modes and in which the quality of the air is healthy no matter how many people live and work in the city, the planning process must also support these goals. Chapter 6 discusses ways in which land-use policies for Toronto can contribute to reducing the volume of automobile traffic in the city as well as vehicle emissions.

In order for all these strategies to have their full impact, it is necessary that people play an active role in making necessary changes in their personal behaviour and adapting their lifestyles to minimize car use. Chapter 7 discusses ways these changes can be encouraged.

A recent study (VHB Research, 1991) for the Ontario Ministries of Energy, Transportation and Environment, examining opportunities to reduce CO_2 emissions through energy efficiency, further supports the initiatives proposed below. The report proposes that a 20% reduction in CO_2 emissions by 2005 can be best achieved through a continuation of economic and regulatory measures such as: the application of a carbon tax, increased incentives for public transit, the substitution of communications technology for auto travel, and regular vehicle inspection and maintenance.

While the term "traffic calming" is not used extensively in this report, the strategies which have been developed implicitly use the principles of traffic calming. Traffic calming refers to an integrated approach to develop "liveable streets", where car traffic is reduced. Traffic calming emerged from the idea that, unlike highways, streets do not exist exclusively for the use of car drivers, and that we can improve the quality of life in urban areas by reassessing the road space available for each activity (Editions Amarcande 1990). Principles of "traffic calming" include dealing with the problems of traffic safety, traffic flow, urban development and the environment in an integrated way, giving pedestrians, cyclists and transit users a more active planning role, creating special areas for non-car uses and, therefore, by design reducing traffic volume, traffic speed and emissions (Topp, 1990). In essence, traffic calming involves a city-wide policy of traffic restraint (Cart, 1990) which is the objective of the strategy laid down in this report.

We begin the next chapter by outlining targets to be achieved in reducing the impact of the automobile in the city.

PROPOSED TARGETS

GOAL 1 *To Reduce the Level of Carbon Dioxide (CO_2) Emissions from Motor Vehicles in the City of Toronto*

In order to achieve this goal, the Technical Workgroup is proposing two targets. These targets, we believe, may be achieved if the full set of recommendations, presented in subsequent chapters of this report, is implemented.

Target *1* A 20% reduction (from 1988 levels) in CO_2 emissions from motor vehicles in the city of Toronto by the year 2005.

This target is consistent with Council's present resolution to reduce CO_2 emissions from all sectors by 2005. We feel this can be achieved in the transportation sector specifically, and that a number of steps (such as increasing fuel efficiency standards) could be phased in and would have significant impacts on per capita energy use. However, the 20% target is only an intermediate goal, as much larger reductions are required to stabilize the amount of CO_2 in the atmosphere, even in the short term.

Target *2* A 50% reduction (from 1988 levels) in CO_2 emissions from motor vehicles in the city of Toronto as soon as possible after the year 2005.

The Intergovernmental Panel on Climate Change (WMO/UNEP 1990) indicates that stabilization of atmospheric CO_2 concentration will require global emission reductions of 50% or more. The longer the delay in reducing emissions by this magnitude, the greater the buildup of CO_2 that will occur. Therefore, it is necessary to aim for substantial decreases as quickly as possible.

An increase in the CAFE (Corporate Average Fuel Economy) standards from 27.5 mpg to 50 mpg by year 2000 is achievable (see Chapter 5) and could potentially reduce carbon dioxide emissions per vehicle-kilometre by 45%, excluding possible increases in upstream emissions associated with the refining of crude petroleum.

GOAL *B* ▶ *To Reduce the Level of Carbon Monoxide (CO), Nitrogen Oxide (NOx) and Hydrocarbon (HC) Emissions from Motor Vehicles in the City of Toronto*

Target *3* A 50% reduction (from 1990 levels) in CO emissions from motor vehicles in the city of Toronto by the year 1995 or sooner.

The concentration of carbon monoxide in the northern hemisphere has approximately doubled since the start of the industrial revolution. A 50% reduction in emissions from northern hemisphere countries is required to return carbon monoxide concentrations to pre-industrial levels and restore the atmosphere's cleansing ability. In as much as road transportation accounts for over half of carbon monoxide emissions in Canada, this sector cannot be neglected in any overall strategy. Data collected in Toronto in 1990 suggest that 10% of the automobiles are responsible for about 50% of the automotive carbon monoxide emissions (see Chapter 5). Bringing these cars up to the average of the majority through routine inspection and maintenance would achieve an almost 50% reduction in emissions.

Target *4* An 80% reduction (from 1990 levels) in NOx emissions from motor vehicles in the city of Toronto by 2005 or sooner.

Nitrogen oxides and volatile organic compounds (non-methane hydrocarbons) lead to the formation of ground level ozone. As large a reduction as possible should be targeted.

In the case of NOx, replacement of the current emission standard of 0.6 gm/km with the California standard of 0.25 gm/km for light duty gasoline vehicles (which is to be in force in Canada by 1994 and in the U.S. by 1996) would achieve a 60% reduction (see Chapter 5). The Tier 2 NOx standard for light duty gasoline vehicles contained in the 1990 U.S. Clean Air Act is 0.125 gm/km but is dependent upon demonstration of technical feasibility; if adopted it would achieve the 80% emission reduction target proposed here, assuming no increase in vehicle kilometres travelled. The proposed date for compliance with the Tier 2 standard by new vehicles is 2004.

A control plan for managing nitrogen oxides and volatile organic compounds (non-methane hydrocarbons) has already been developed by the Federal/Provincial Committee on Long Range Transport of Air Pollutants. If implemented, this plan will reduce emissions by 25-50% (1985 levels and keeping the number of vehicles constant) in the Windsor-Quebec corridor, of which Toronto is a part.

Target 5 A 50% reduction (from 1990 levels) in hydrocarbon emissions from motor vehicles in the city of Toronto by the year 2005 or sooner.

Hydrocarbons have toxic and carcinogenic effects which increase as the volume of automobiles on the road increases. VOC's (non-methane hydrocarbons) combine with NOx to form low-level ozone. As with NOx, therefore, as large a reduction as possible should be targeted. A reduction of at least 50% should be achievable without fuel switching. The adoption of the California Standards (see Chapter 5) should achieve this 50% reduction in hydrocarbon emission in the city, if the number of vehicles and congestion conditions remained the same.

Technical measures alone, however, will not achieve the proposed emission reduction targets for CO_2, CO, NO_X and volatile organic compounds and hydrocarbons. This is because the number of cars which travel in the city continues to increase and is likely to continue increasing as the population of the GTA grows. As well, it could be well into the next century before the foreseeable technical measures and proposed standards have fully penetrated the transportation fleet. It is therefore prudent, if these targets are to be achieved, to attempt to shift as many automobile commuters as possible to less polluting modes and to try to induce ride-sharing among the remaining automobile users; this serves as insurance against failure of the technical measures to perform as expected as well as accelerating the date when the emission reduction targets are achieved. Therefore, two additional targets are proposed to reduce emissions and to satisfy the goal of reducing urban traffic.

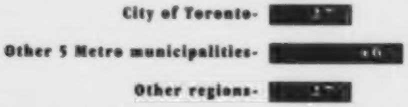
GOAL ▶ *To Minimize the Volume of Traffic and Its Effect on the Quality of Life in the City of Toronto.*

In order to achieve this goal, the Technical Workgroup is proposing two targets, as follows:

Target 6 A 15% reduction (from the 1986 level) in the proportion of daily trips into the central area made by automobiles by 2005.

This target, which aims to reduce the proportion of people who use automobiles to travel in the city, is necessary if the emission reduction targets outlined above are to be achieved.

Data from the Transportation Tomorrow survey (1986) indicates that automobile drivers travelling into Planning District 1 come from the following areas within the Greater Toronto Area:



In other words, the majority (73%) of drivers to Planning District 1 originate in Metro Toronto, which is already well served by transit (Miller, 1990). Hence, there is considerable opportunity to increase the proportion of these trips handled by transit and other modes. This shift can favour public transit, cycling and/or walking. The report recommends several ways in which conditions for public transit, cycling and walking can be enhanced.

Target 7 A voluntary reduction in personal car use by 20% by residents of the City of Toronto.

This target signals the important role that individual behaviour change can make in achieving environmental goals. For some people, the change could be choosing not to drive one day out of five; for others it could be walking, cycling or taking transit for 20% of trips when one would usually drive; for others it could mean doubling up with someone instead of taking two cars or planning errands so several can be done in one trip.

Chapter 7 outlines a public education campaign designed to help people make these choices.

To achieve these seven targets, the Technical Workgroup has developed a strategy which includes the following critical elements:

- enhancing public transit
- limiting vehicle emission
- promoting the use of the bicycle
- addressing the needs of pedestrians
- changing land use in the city, and
- developing a public education and behavioral change campaign to encourage reduced automobile use.

The following chapters discuss ways to implement these critical elements and achieve the emission and vehicle use reductions proposed here. The effectiveness of the strategy can be assessed against the targets set above.

3. Making Better Use Of Existing Streets

If we want to encourage people to use alternatives to the automobile, it is necessary to make the options of transit, walking or cycling more attractive. At the moment, Toronto streets are almost exclusively devoted to the use of motor vehicles. This chapter discusses ways that the streetscape can be redesigned to give greater weight to transit, cycling and walking uses.

This can be accomplished at low costs in the short-term. These proposals are a crucial first step of this phased approach towards reducing the volume of automobile traffic and vehicle emissions in Toronto.

TRANSIT FIRST

Public transit in Metro Toronto is a viable, energy saving way to reduce emissions and vehicle kilometres travelled and the City of Toronto is fortunate to have an extensive public transit system. However, perception

The Bay Street Urban Clearway, where the curb lane in each direction is reserved for TTC trolleys, taxis and cyclists, is an example of how we can make better use of downtown streets.

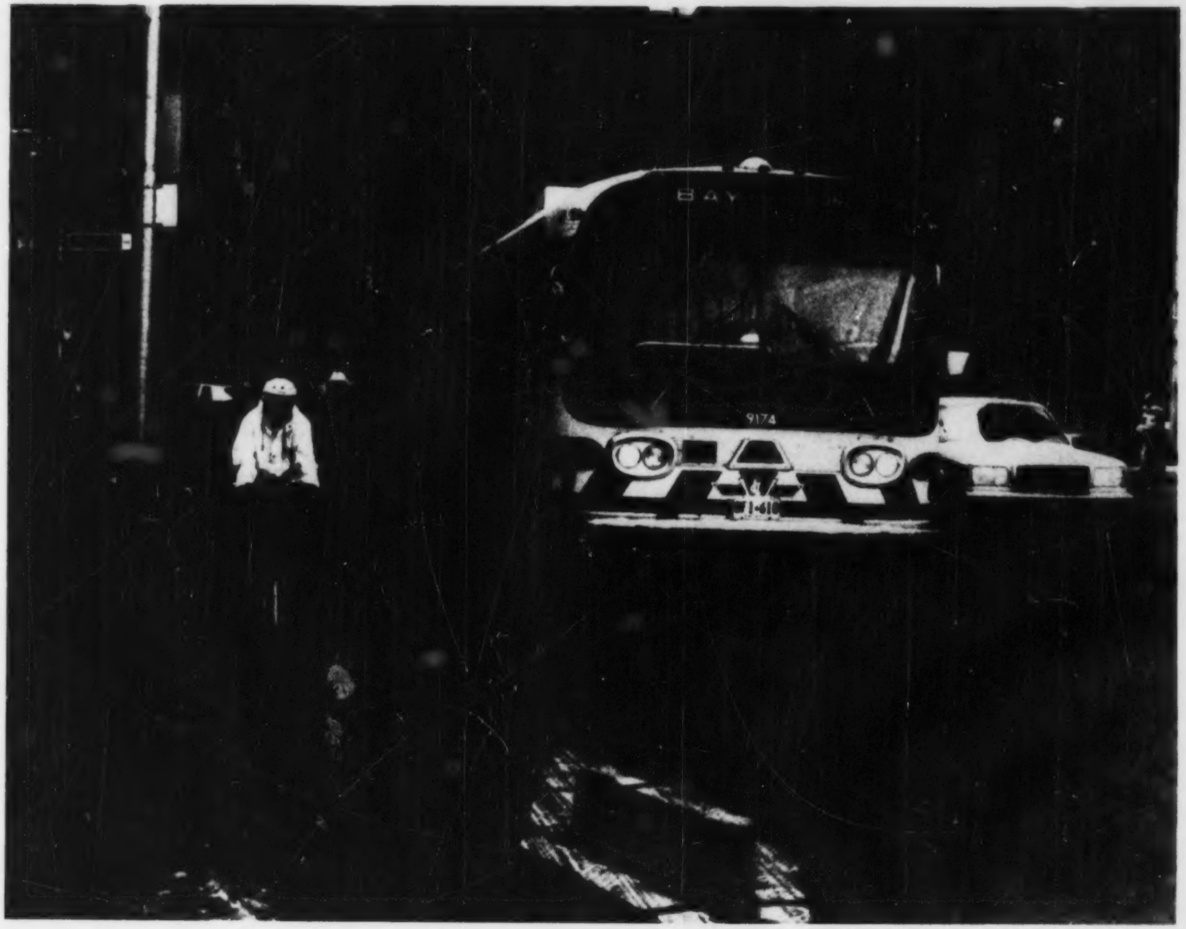


Photo by Vince Pietropaolo.

of the TTC is increasingly negative, and the public is voicing dissatisfaction with subway reliability, delays on surface routes, safety, overcrowding, fare increases and lack of access for people with disabilities, people with strollers and the elderly (Burak Jacobson 1990). Yet, TTC ridership of 459.2 million for 1990 is 1.9% higher than ridership in 1989. This is second only to 1988's record level of ridership.

In fact, growth in the use of public transit in Metro has occurred at a faster rate than use of the car. From 1975 to 1988, there was a 259% increase in the number of person trips across the Metro cordon on public transit and a 33% increase across the Central Area cordon, compared to increases of 143% and 12% respectively for automobiles (see Appendix 3 for map showing the cordons).

While these increases are encouraging, only 47% of trips over the entire day to Planning District 1 (PD1), which is roughly equivalent to the central area of the city, are made by transit (Exhibit 8). As well, only 26% of all trips into Metro on a 24-hour basis are by transit. During the morning rush hour, transit usage is somewhat higher, accounting for 58% of trips to PD1 and 33% of trips into Metro.

These figures indicate that there is considerable room for growth in use of transit. However, commuters will be converted to the transit system only when it provides an alternative to the car which is at least as fast (Burak Jacobson 1990).

The first step in increasing the use of public transit is to improve the existing system. Eliminating interference with traffic flow from automobiles and trucks will improve the speed and level of service of buses and streetcars. Currently it is estimated that traffic congestion costs the TTC $1.9 million each year, an amount growing $350,000 annually over the past five years. The TTC has had to purchase an additional 23 vehicles since 1984 merely to maintain the same level of service in the face of growing traffic congestion.

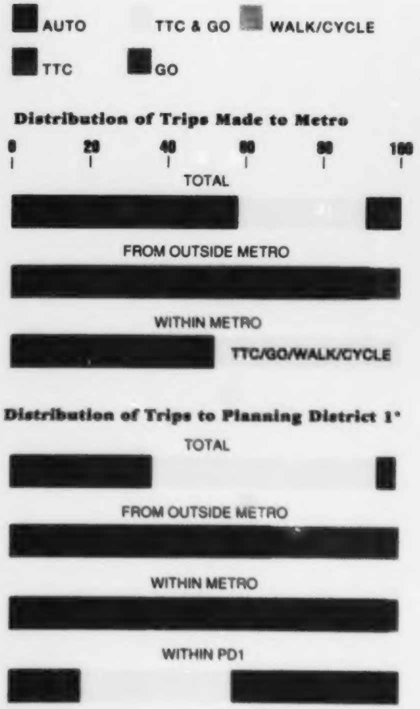
Introducing "transit priority initiatives" is one way to reduce congestion. Data from TTC attitude surveys highlight the strong support for transit priority initiatives, even among non-riders. Eighty-four percent of riders and non-riders favour giving TTC vehicles turning priority at more intersections, and 82% favour

The POP (Proof of Payment) system that allows passengers with Metropasses or valid transfers to enter by the rear doors of the Queen Street streetcar should be expanded to other routes, to reduce traffic delays.

Photo courtesy TTC.

EXHIBIT 8

DISTRIBUTION OF MORNING RUSH HOUR TRIPS INTO METRO TORONTO AND PLANNING DISTRICT 1* BY TRANSPORTATION MODE



*Planning District 1 is roughly equivalent to the Central Area of the City of Toronto

Source: Ontario Ministry of Transportation 1989; Municipality of Metropolitan Toronto 1990; Municipality of Metropolitan Toronto 1989

reserving lanes (clearways) for TTC, taxis and emergency vehicles (Burak Jacobson 1990).

Currently, the City is conducting a pilot project of such a transit priority clearway on Bay Street. During weekdays, one lane of traffic in both directions is available only for transit buses, taxis, bicycles and emergency vehicles. While this type of clearway exists on other Metro roads during rush hour, Bay Street represents the first full-day urban clearway. Similar initiatives on King and Queen Streets are under consideration by City Council.

During the first 6 months of transit priority on Bay Street trolley coach travel time fell by 11%, bicycle use rose by 80%, traffic volume went up 9% and TTC ridership satisfaction was high. A 12 month evaluation will look at other issues including impacts on surrounding areas.

In addition, five or six different sections of Metro roads with heavy transit use are investigated yearly by TTC and municipal staff. Locations with significant transit delays along each road section are analyzed with respect to a broad range of potential alternative transit priority measures or other operational improvements. The recently completed Transit Priority Study 1990, focused on portions of Bathurst Street, Dufferin Street, Eglinton Avenue West, King Street and Ossington Avenue. The results of this study will be available shortly.

Isolated transit priority measures however, may simply aggravate traffic problems on adjacent streets, thereby increasing the pollution problem. Consequently, these measures must be implemented on all major arteries throughout the city so that motorists will respond by leaving their cars at home, thereby reducing emissions.

In the City of Toronto there is an extensive infrastructure of streetcar tracks with a route length of 70 km. During rush hour periods, over 200 streetcars are in operation. About 300,000 TTC passengers use streetcars on at least a portion of their trips every working day. However, the existing streetcar network is used inefficiently due to traffic congestion caused by the minority of commuters who travel into or within the City of Toronto by automobile.

Sixty-five percent of people who cross the central area cordon (see Appendix 3), during the morning peak

Improving transit service in the City, and making it easier for people to bicycle and walk to work will help reduce auto commuting, and auto emissions, the major source of air pollution in Toronto.

Photo courtesy TTC.

period, do so by TTC or GO transit, while 35% of people entering the central area do so by automobile; yet this latter group is responsible for most of the road congestion (Municipality of Metropolitan Toronto 1989). Along parts of some streetcar routes, for example Queen Street in the Beaches and Queen Street in the west, curbside parking is permitted during rush-hour, which also contributes to inefficient use of the streetcar system, as cars entering or leaving parking stalls are a further cause of delay. At intersections, a single car with one occupant waiting to make a left hand turn can delay a fully loaded vehicle carrying 75-110 passengers. The TTC also has a large stock of diesel (1,687) and trolley (139) buses which must share road space with automobiles, thereby leading to inefficient use of these vehicles as well.

To make Toronto streetcars and buses efficient, rapid and reliable modes of transit will require bold and sweeping changes in the ways city streets with major transit routes are used at present. We propose the following "package" of measures which, to be effective, should be implemented system wide. Many of these measures have already been implemented in major European cities.

Most major arterial roads in the City of Toronto are Metro roads. In order to implement the following set of recommendations, the City and Metro must work together to optimize the benefits of the following package of measures.

Rush Hour Measures:

Recommendations: 1. That the City of Toronto and the Municipality of Metropolitan Toronto establish a complete grid of surface transit priority lanes on major roads in the City of Toronto to ensure speedy access to all points in the city. This system should include the following:

1a. That the City of Toronto, in conjunction with the Municipality of Metropolitan Toronto, prohibit driving on streetcar tracks in both directions during rush hours. The only exceptions would be for emergency vehicles and at the approach to selected intersections so as to facilitate turning movements.

1b. That the City of Toronto, in conjunction with the Municipality of Metropolitan Toronto, prohibit driving in bus priority lanes in both directions during rush hours. The only exceptions would be for emergency vehicles, bicycles, at the approach to selected intersections so as to facilitate turning movements, and taxis where appropriate.

1c. That the City of Toronto, in conjunction with the Municipality of Metro Toronto, totally prohibit curbside parking or stopping on all major transit routes in both directions during rush hours. The prohibition would take effect one half hour before rush hour on these routes to permit removal (towing) of violators.

1d. That the City of Toronto, in conjunction with the Municipality of Metropolitan Toronto, prohibit left turning movements on the streetcar priority routes at all except a very limited number of intersections, and prohibit right turning movements on bus priority routes where such movements would delay bus flow. Appropriate measures should be taken to ensure that residential streets are not adversely affected.

2. That the City of Toronto request that the Municipality of Metropolitan Toronto implement a streetcar traffic light priority system for public transit vehicles. A more detailed discussion of this system is provided in Appendix 7.

3. That the City of Toronto request that the Metropolitan Toronto Police Force increase enforcement of driving, parking and stopping restrictions on new transit priority routes.

4. That the City of Toronto request that the Municipality of Metropolitan Toronto and the other area municipalities undertake similar transit facilitation measures on their major roads.

5. That the City of Toronto urge the TTC to allow loading and unloading of passengers at the front and middle doors of streetcars and buses to encourage faster loading and unloading. This system is currently being tested on the Queen streetcar route.

6. That the City of Toronto request that the TTC assess a system-wide transfer system in which TTC patrons could break travel trips as many times as desired within, for example, one hour of paying a fare.

7. That the City of Toronto request the TTC to assess the feasibility of direct streetcar routes destined for the Central Area, along existing tracks, similar to the "downtowner" that had been tried in the late 1970's/early 1980's. The purpose of these would be to alleviate congestion on the Yonge Street subway and to minimize the number of physical transfers required of transit patrons (see Appendix 5).

Non Rush Hour Measures:

8. That the City of Toronto, in conjunction with the Municipality of Metropolitan Toronto implement recommendations 2, 5 and 6 around the clock.

In Appendices 5 and 6, we present data indicating that there are enough automobile commuters living and working in the city of Toronto, or living outside the city and working in the city who are well served by TTC/GO transit, such that, if they switched to TTC/GO, the reduction in automobile use would be enough to compensate for the loss of road space available to automobiles. We also present data that suggest that the improvements in service resulting from dedicated bus and streetcar lanes, combined with other feasible measures, would be sufficient to induce enough of these commuters to switch to TTC/GO to compensate for the loss of automobile lanes.

The proposed transit priority measures, which could be implemented immediately along with other rapidly implementable measures, could result in overall traffic volume reductions of 30-35% (see Appendix 5). Furthermore, the increased transit speed of streetcars would be sufficient to accommodate the initial increase in TTC ridership on streetcar routes without the need to purchase additional streetcars.

We wish to stress that the desired outcome of these proposals is to reduce the total number of cars on the roads within the City of Toronto by inducing as many people as possible to shift from automobiles to transit. We are not interested in simply shifting cars from streetcar to non-streetcar routes, although that will undoubtably occur to some extent, at least initially. A prime target population is the group of commuters who live in Metro Toronto and work in the City of Toronto. There will likely be increased traffic chaos and congestion initially as automobile commuters resist giving up their habit of commuting by automobile. However, if parking prohibitions, and prohibitions against driving on streetcar tracks or in bus lanes and against left turns from streetcar tracks are adequately enforced, the streetcars and buses will flow more efficiently. The increased impediments to commuting by automobile will serve as yet another reason for switching to TTC.

Although sufficient data to accurately quantify the average increase in streetcar and bus speed that would

The best way to encourage commuters to leave their cars at home is to make the public transit alternatives more attractive. A case in point: the introduction by the TTC of designated waiting areas on bus and subway platforms. This initiative helps address the safety concerns of passengers, and women in particular, who are the greatest users of transit.

DWA
Designated Waiting Area

Photo courtesy of the TTC.

result from the proposed rush-hour measures do not exist, there is no doubt that significant improvements would occur. Limited data presented in Appendix 5 suggest that the improvement could be 30-40%, although more data are required to accurately assess the improvement that would occur. Whatever the improvement, a given decrease in travel time implies the same decrease in vehicle headway (average time between vehicles), an increase in passenger carrying capacity and, if the passenger carrying capacity increase is realized, there will be an increase in revenues without the need to purchase any additional vehicles. In other words, if system-wide transit priority measures increase average vehicle speed by 30%, this is equivalent to a 30% increase in the vehicle stock without the need to spend any tax dollars purchasing new vehicles.

Lastly, given that the number of people living and working in the City of Toronto is projected to grow over the next 15 years, it is clear that improving the speed of the existing stock of surface vehicles will not be sufficient in the long run. The transit measures proposed here should be accompanied by other measures discussed in detail elsewhere in this report in order to improve the probability of success in shifting commuters from automobiles to transit and reducing emissions. We cannot over-emphasize the importance we attach to an integrated, comprehensive approach in reducing automobile use.

MAKING TORONTO'S TRANSPORTATION SYSTEM AVAILABLE TO ALL

Toronto's public transit system was not designed to meet the needs of many people in our city, particularly the elderly, parents with children, people with disabilities, and women concerned about safety. If we are to truly develop an accessible transportation system which offers a viable option to the automobile, we must take into consideration the diversity of our population, and develop the system accordingly.

For many elderly, the steps on and off the streetcars and within the subway system are impossible to manoeuvre. Parents with strollers tell of the difficulties they experience carrying heavy children and strollers down flights of stairs into the subway station and through turnstiles. They also tell of hostile bus drivers who stare impatiently as they try to lift strollers, unaided, onto the bus.

The TTC's Community Bus is a good example of how the public transit system can be made more accessible to those who depend upon it the most.

Photo courtesy of the TTC.

People with disabilities, while acknowledging the vast improvement for them with the advent of Wheel Trans, look forward to the day when they can have a transportation system with greater frequency, and which can better accommodate their needs (11.9% of request for Wheel Trans were rejected in 1988).

Many women fear taking public transit late at night, or in isolated areas, particularly when coming home from shift work. The increase in women working outside the home over the past decades has increased the demands and requirements on the urban transportation system, but has scarcely been considered in the planning of service. In some areas, women cannot participate in activities because public transportation options are poor, and they cannot afford a car. Unequal allocation of family resources often means that men have access to the automobile and women are forced to rely on slower and less flexible public transportation.

Women, therefore, are more than twice as likely as men to use public transit. Women are the majority users of public transit, and half of all GO transit rail users. In a study in Scarborough, the average female transit user spends 415 hours a year commuting as contrasted with the average car commuter who spends 180 hours (Rutherford and Wekerle 1988).

In general, women tend to make more multiple stops while using public transit. As such, they are often required to incur an extra fare cost. While the day pass is an option on the TTC, it does cost more than two one-way fares, and is less widely available. The flexibility of the day pass is therefore an important consideration as is the need to allow passengers to make multiple stops along their particular routes, as is recommended in the previous section.

In addition, the proportion of women and elderly tends to be higher during the non-peak hours. As a result, they experience less frequent public transit service. Many groups representing women and the elderly have stated that they would prefer smaller transit vehicles travelling more frequently during off-peak hours. The new TTC community bus in the Lawrence/Bathurst area is attempting to address some of these problems in a particular neighbourhood.

The TTC has recently studied the mobility needs of the disabled and elderly persons, with a view to expanding service. A report, entitled 'Choices for the Future', published in August 1989, recommends ways to improve subway accessibility, community oriented bus service, kneeling buses, lift-equipped conventional transit buses, Wheel Trans, and the provision of additional escalators in subways (TTC 1989).

A second report, entitled 'Moving Forward' recommended actions to improve equal access to the transportation system, including substantive changes to a system that needs to address women's concerns about safety, and be responsive to their experiences of harassment and assault (TTC et al. 1989). Several recent initiatives have addressed some of the concerns highlighted in the report: 'designated waiting areas' are specific locations on the subway platform which are always visible to attendants; along certain transit lines in Scarborough, women can request a special stop anywhere along a route in the evening.

A significant public consultation process is necessary in order to adequately address the concerns of the groups with special needs. The TTC has begun to address the concerns which have emerged from these two reports. However, it is important that an ongoing consultative relationship is maintained and that the groups with special needs become a resource for identifying the areas where special services are required.

There is still considerable room for improvement to ensure that all members of the community have access to an equivalent standard of service.

Recommendations:

9. That the City of Toronto continue to encourage the ongoing efforts of the TTC to provide an equal level of service to groups with special needs.
10. That the City of Toronto encourage the TTC to enhance its current public consultation process to formally involve citizens and community groups in assessing priorities and service needs.

ROADS FOR CYCLISTS TOO

Bicycles, which have been neglected in most of North America in favour of motor vehicles, offer a viable option to the car. Bicycles consume no fuel, require less space and produce no pollution compared to other forms of transport, except walking. They also provide convenient, personal travel up to five times faster than walking. Cycling also adds to the vitality of street life and offers exercise and recreational benefits. In addition, it is a mode of transportation open to a wide range of income groups (Melaragno, 1990). In mixed traffic, such as that found in urban centres, bicycles can move seven to ten times as many people per metre width of lane per hour as autos travelling at the same speed.

Canada produces 1.5 bicycles for every automobile, yet cycling makes up a very small proportion of passenger trips compared to European countries. For example, in Toronto, 3% of daily vehicle trips are by bicycle compared to 43% in Delft, Netherlands, 25% in Tokyo, Japan and 20% in Copenhagen, Denmark. Public policy in these countries actively promotes cycling through route construction and maintenance and parking facilities. There is considerable room for such initiatives in Toronto (Lowe, 1989).

Nonetheless, cycling has become a growing mode of transportation in Toronto. The Department of Public Works and the Environment cordon counts show a 270% increase in bike trips into the Central Area since 1976, compared with an approximately 25% rise in motor vehicle trips. A 1986 City Cycling Committee survey revealed that there are at least 355,000 adult cyclists in Metropolitan Toronto, and 104,000 in the city. A follow-up study in 1991 will measure the five year growth rate since 1986. Metro Toronto Police now have 20 officers who patrol on bicycles.

Despite the tremendous growth in the bicycle's popularity, the number of bike-to-work trips could be increased significantly through promotion and provision of facilities. A 1989 survey of cycling enthusiasts conducted by the City Cycling Committee revealed that while most respondents use their bikes for personal errands (79%) and for recreation (94%) fewer than half ever bike to work. The 1989 Central Area Residents Survey revealed that the bicycle was the primary means of getting to work for only 7.8% of residents living in the Central Area.

Many people do not see cycling as an option because of the inconvenience, the lack of safety, or because they have simply never tried it. Influencing choice of transportation mode requires changing entrenched habits: if one has never cycled to work, commuting by bike is simply not seen as an option. The Cycling Committee's

Toronto needs an expanded network of safe on-street and off-street bike lanes and paths to encourage more commuter cycling.

Photo courtesy of the Toronto City Cycling Committee.

Bike-To-Work program encourages people who have never commuted by bike to try it. By doing it once, the chance that they will do it again increases.

Facilitating Cycling

While encouragement programs are important, bicycle commuting will never reach its full potential as long as Torontonians perceive that the streets are not safe for cyclists. Eighty-nine percent of all respondents in the survey of cycling enthusiasts said concern for safety discourages bike use. Their primary concerns are traffic conditions, lack of bike lanes, and road conditions. Almost half of the respondents to the 1989 survey (46%) had a bike accident in the past five years, and 58% knew someone who had an accident in the past year.

Bicycle facilities that make cycling safe and convenient - separate paths, bike lanes on the street, and wide curb lanes - will encourage people to use their bikes more often, just as the convenience of blue boxes has encouraged Toronto residents to recycle. Approximately 27% of cyclists who don't use their bikes to get to work or school could be encouraged to cycle commute with the provision of bike lanes, according to the City Cycling Committee's 1989 survey of cycling enthusiasts.

While every street must be considered a cycling street, priority should be given to identifying and improving those streets with high cycling demand. A network of safe bike routes as dense as the arterial road network is for cars could make riding a bike as safe and convenient as driving a car or taking the TTC in the city.

On November 12-13, 1990, City Council approved a City Cycling Committee study to identify and design the first north-south and east-west commuter bike lanes across the city of Toronto. The routes recommended by the study, to be completed by summer of 1991, would form the spine of a proposed network of bike routes whose primary purpose would be to move commuters in and out of the core area. The Committee's objective is to construct at least one section of the recommended routes in 1991.

Providing recreational opportunities for cyclists can be another important step for attracting people to cycling. With Toronto's recreational trails already operating at capacity on summer Sundays, new recreational opportunities can be provided at very low cost by simply closing roads to cars on Sundays. Several cities already prohibit automobiles on Sundays on key urban streets. Ottawa closes the Ottawa River Parkway, Vancouver closes Stanley Park roads, and Seattle closes Lake Washington Boulevard for their monthly Bicycle Sundays during the summer. In Bogota, Columbia, half a million city residents cycle, walk, jog and roller skate every Sunday morning on 56 kilometres of arterial roads that are closed to cars in a seven year old program called "the city for the citizens". A "Green Sunday" in Toronto, where certain arterial streets are reserved for non-polluting uses, would provide excellent recreational opportunities for city residents. Regular street closures on Sundays, the day when the streets are least in demand, might also be a non-threatening way to introduce the concept of restrictions on automobile use in the city. Currently the city closes the roads through High Park on Sunday.

Chapter 4 discusses bike-to-transit trips and parking for bicycles is discussed in Chapter 6.

Recommendations:

11. That the City of Toronto adopt as a high priority the development of a network of on-street bike lanes.
12. That the City of Toronto support programs which aggressively promote bike commuting to work and school, such as the City Cycling Committee's Bike-To-Work Program, and that Metro be encouraged to do the same.
13. That the City of Toronto and the Municipality of Metropolitan Toronto jointly sponsor a pilot project in 1991 in which certain streets would be closed to cars on Sundays to provide safe opportunities for non-polluting recreation and travel in the city.

SPACES FOR PEDESTRIANS

Toronto's pedestrians are an integral part of the city's streetscape and streetlife. Walking is part of almost every trip and the most basic mode of transportation. It is an important component of both the transit and the auto journey, getting people to and from transit or parking areas. Forty percent of downtown residents currently walk to work, relying solely on walking as their mode of commuting. As well, walking is an important way people experience the city and keep the streets vital and safe. Improving the pedestrian environment in the city, therefore, is an integral part of the proposal to make better use of the existing public streets. Pedestrian

More needs to be done to make the City's streets and public spaces safer for everyone and more accessible for people with disabilities. Wider sidewalks, more trees and street furniture, improved street lighting, and better weather protection over sections of sidewalks in the downtown core are all needed if we are to encourage more people to walk to work.

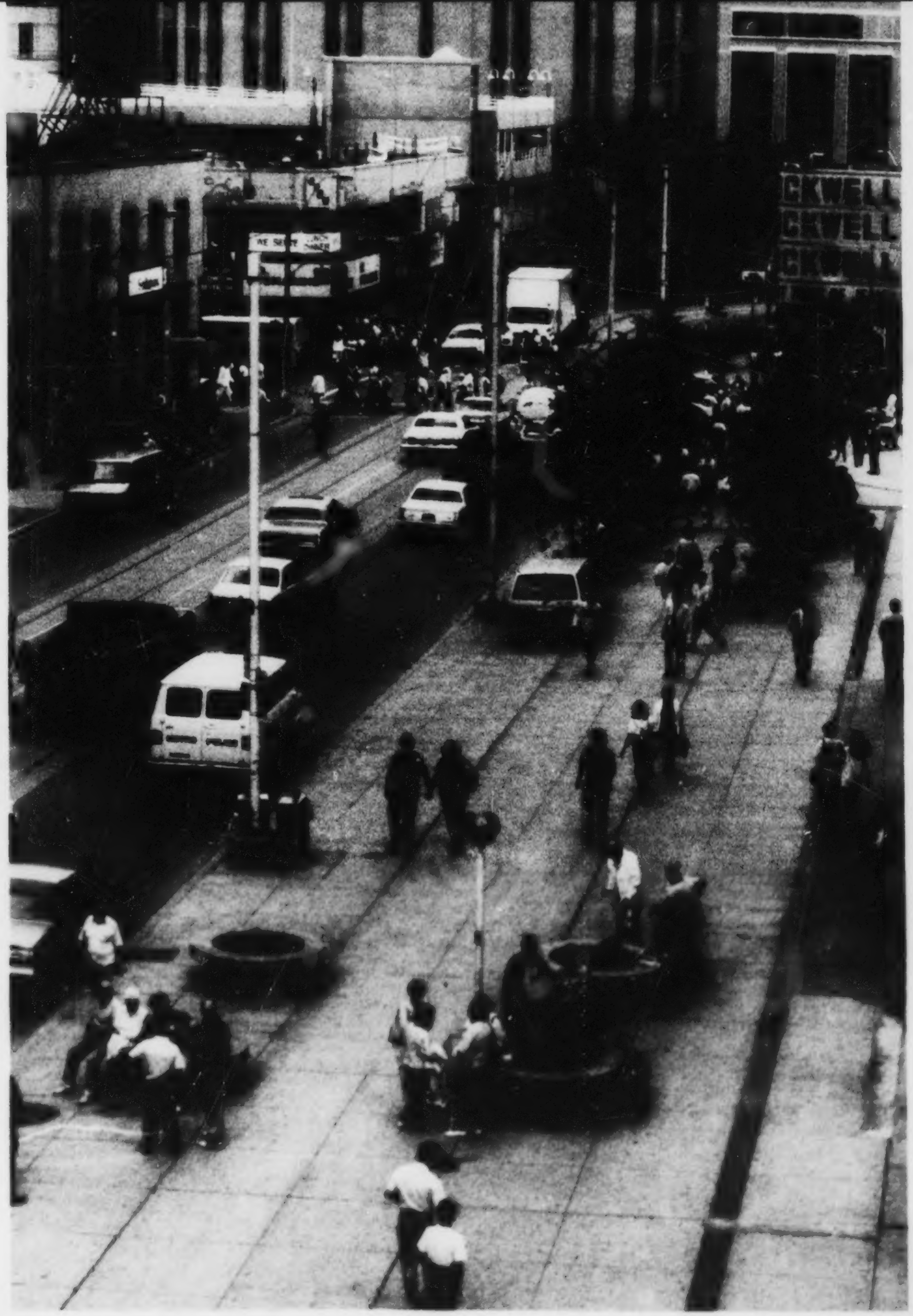


Photo by Vince Pietropaolo.

zones created within the city centre are a key component of traffic calming schemes (Topp, 1990).

There are several areas of concern to pedestrians, many of which are currently being addressed by the City.

Circulation

The most important consideration for people who rely on walking in their daily commute is the ability to take the shortest route with the least number of obstacles. Obstacles exist where streets cannot easily be crossed, subways are difficult to access, sidewalks are overcrowded, and weather protection and safety are poor. Most people get to public transit on foot; therefore, it is important that stations and stops be easy and comfortable to reach in this way (Garbrecht, 1990).

Pedestrian crossings at street corners coincide with the right turning movements of cars on a parallel course. As a result, people crossing the street often feel rushed and vulnerable to accidents. A proposal is currently being reviewed by the Metro Transportation Department for the implementation of exclusive "pedestrian phase" traffic control signals in conjunction with the Bay Street clearway. A "pedestrian phase" crossing would stop traffic in all directions to allow pedestrians to cross in any direction, including diagonally.

Pedestrian crosswalks provide a special crossing privilege only to walkers. Because of safety concerns, all existing and proposed pedestrian crosswalks on streets are currently being converted to the new "early warning" system to improve safety. These crosswalks will have one or more illuminated signs displaying a large "X" symbol and flashing amber lights, which are activated by the pedestrian to indicate to oncoming traffic the intent to cross.

Sidewalk widths are an important factor for pedestrian circulation in the Central Area. The standard width of a sidewalk, measured from the curbface, is generally 1.7 m. Wider sidewalks are often provided in major development proposals. For instance, the new CBC site, bounded by Front Street West, Simcoe Street, John Street and Wellington Street West, will have a minimum 3.0 m wide setback for pedestrian purposes around the entire block, in addition to the public sidewalks.

Because it is more difficult, technically and politically, to widen sidewalks after adjacent properties have been developed, it is important to ensure that an unencumbered pedestrian corridor is maintained, by placing street furniture, such as benches, tree planters, etc. in a location that maintains the minimum sidewalk width for pedestrian use.

Other obstacles to pedestrian circulation include service vehicles, and in some cases street vendors. Street vendors are required to ensure a minimum width of 3.66 m of clear sidewalk. Currently the City is phasing out the permits which allow vendors to operate on sidewalks which do not conform to the standard. Service vehicles which load and unload on the sidewalk or from the street onto the sidewalk should be discouraged.

Proper maintenance of sidewalks is important for both circulation and safety reasons. The City is responsible for the maintenance of all sidewalks within its borders. Of major concern to pedestrians is the removal of snow and ice in the winter. A recent review of the City's "Be nice, clear your ice" campaign indicates that the program is becoming more effective in making the public aware of their responsibility to clear snow and ice within 12 hours of a snowfall. Full compliance within this time frame, however, is difficult to achieve. This is because the City must first issue a notice for non-compliance before clearing the sidewalk and issuing a bill. While the compliance rate following the issuance of notices is quite high, there remains a long period between the snowfall and the clean-up. If, on the other hand, the City were to simply clear all sidewalks which are not cleared within 12 hours (and issue bills to the residents whose walks must be cleaned), conditions for pedestrians following a snow storm would be improved. More capital investment could be required to meet this service.

Snow accumulation at the curb makes crossing streets very difficult. For parents with strollers, snowy and icy curbs and sidewalks are particularly unmanageable. Special attention should be focused upon providing clear passageways at all street corners for pedestrians.

Pedestrian Amenities

Studies of traffic calming projects in Europe indicate that the physical amenities available to pedestrians play an important role in the recreational and service choices of communities (Editions Amarcande 1990). If

Developers should provide off-street loading and courier facilities when planning complexes or upgrading older buildings to avoid traffic tie ups and unnecessary idling, and in order to give pedestrians full access to the sidewalks.

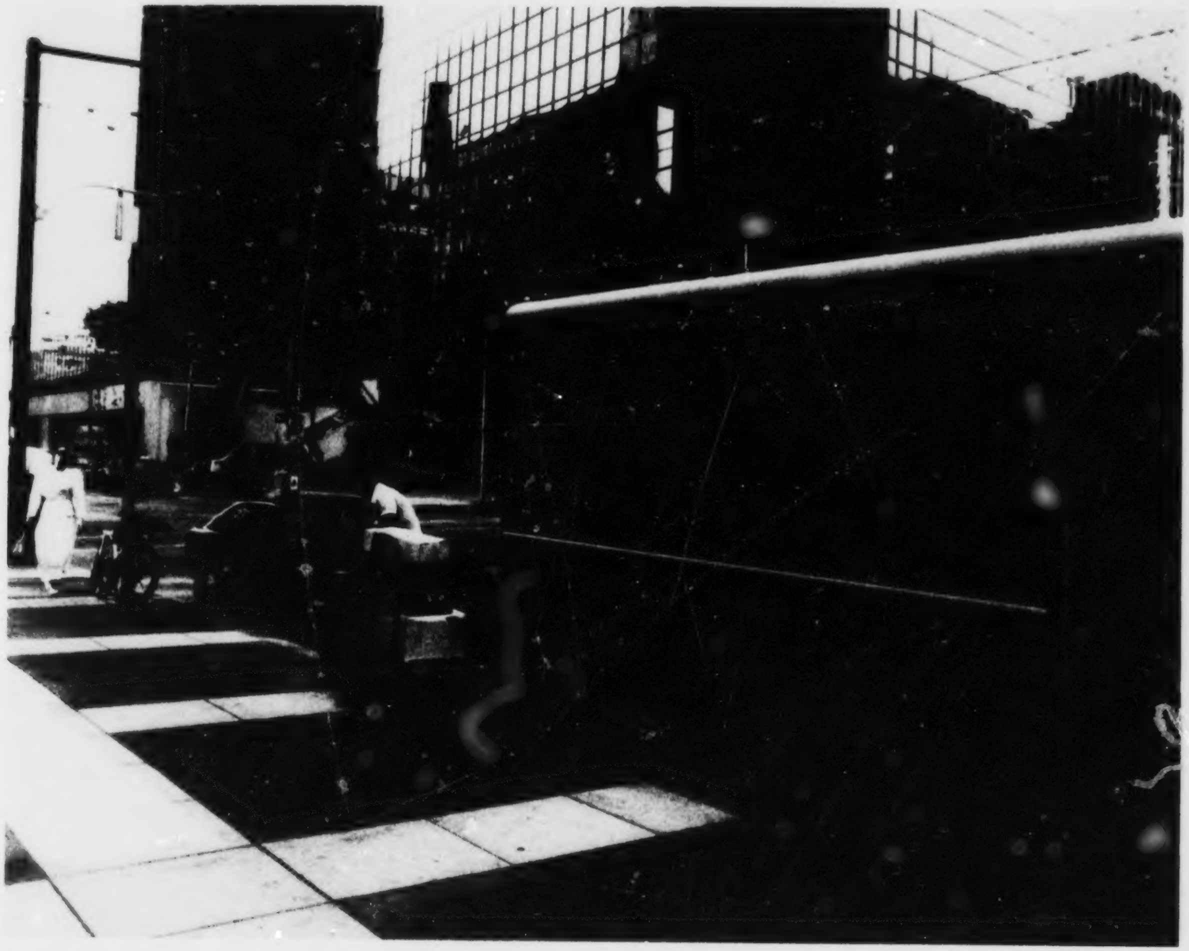


Photo by Vince Pietropaolo.

people are satisfied with the pedestrian environment in their neighbourhood, they will use the services in their neighbourhood more frequently and drive to other locations less frequently.

Sunny streets enhance the comfort level for many pedestrians, as does adequate protection from wind and rain. Not only do trees provide needed shade in the summertime, but they buffer the noise from motor vehicles, cool down the immediate surrounding environment through transpiration when it is warm and absorb CO_2 from the atmosphere. Toronto, which is a city of neighbourhoods, should continue to expand upon existing efforts to provide street level weather protection, tree planting, sheltered walkways, benches, drinking fountains, etc. Built form regulation is necessary to ensure comfortable conditions of sun and wind on city streets.

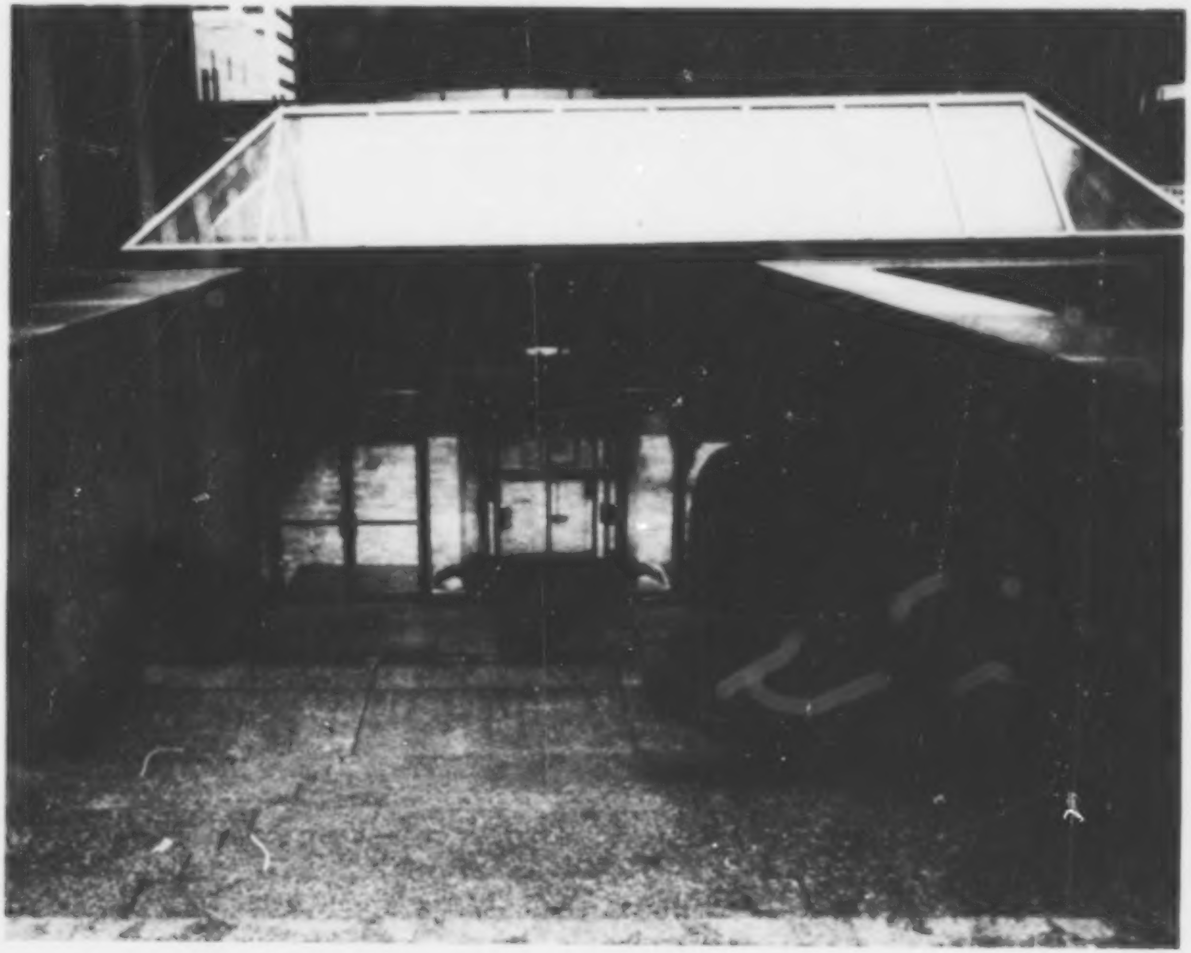
In addition, merchants should be encouraged to provide services such as local grocery delivery and in-store lockers, which would encourage residents to walk to shops in their neighbourhoods.

A specific focus of the Task Force on the Gardiner/Lakeshore Corridor is to improve the landscape, streetscape and lighting quality adjacent to and under the Gardiner Expressway. Currently, the Task Force has completed a study which recommends ways to improve the streetscape for pedestrians along lower Yonge Street.

An existing form of pedestrian mall in the downtown area is the extensive underground pedestrian network in the Central Core. This network extends 19 km and now runs from Elm Street to Union Station. The system provides links to 38 office towers in the financial district, three major hotels, Union Station, five subway stations, and is within one block of the entrances to several major attractions such as the Skydome, theatres, the CN Tower, etc. The mall's weather-protected links to TTC and GO Transit stations also serve to enhance the accessibility of public transit. To make the underground network more usable, the City is planning to improve the signage to destinations in the mall. Installation of the new signs will begin in 1991.

Safety

Public safety is a significant concern to all Toronto residents. Fear is a particular deterrent to walking and using public spaces. Many women feel they must drive to work because they fear the walk to and from transit stops. In addition to current law enforcement practices, the City must continue to incorporate public



Toronto's underground retail city — the network of malls beneath the office towers, hotels, and high-rise apartments of downtown — provides a safe, weather protected route for pedestrians

Photo by Jocelyne Richards,
City of Toronto Archives.

safety concerns into the physical design of the pedestrian environment. The City should discourage designs which separate pedestrians from other users of the streets because these can present safety hazards, especially when underused.

In addition, the City should encourage small scale street level activities to animate city streets. This would increase the potential for surveillance, thereby enhancing public safety.

Special Needs Groups

Pedestrian sidewalk ramps are gradually being added at all intersections to make the sidewalks accessible for all persons. This occurs when sidewalks are reconstructed or where there is an immediate need. This will allow people with disabilities the opportunity to circulate more freely and allow parents to push their strollers more easily from one block to the next. As with safety considerations, the physical design of all pedestrian facilities should, in the planning phase, incorporate the specifications of special needs groups.

Promotion of Walking

In Ottawa a citizens' group, called Ottawalk, has been formed to promote walking and improve pedestrian safety in the city. Such a group could have an important role to play in helping to encourage walking in the same way the City Cycling Committee fosters bicycle use.

Recommendations:

14. That the City of Toronto investigate the potential for restricting on-street truck loading in areas with heavy pedestrian traffic to off-peak hours.
15. That the City of Toronto allocate the resources necessary to clear snow and ice from all sidewalks in the city after the 12 hour period following a snow storm is over and charge building owners for costs.
16. That the City of Toronto ensure that the curbs at all street corners and pedestrian crosswalks are cleared of snow immediately following snow clearing on streets and encourage Metro to do the same on Metro roads.
17. That the City of Toronto ensure that public safety and access considerations be incorporated into the design of physical spaces for pedestrians, particularly in the areas of subway accesses, street lighting, underground tunnels and underpasses and sidewalks.

18. That the Technical Workgroup on Traffic Calming and Vehicle Emission Reduction, through the Healthy City Office, report to City Council on the ways in which pedestrian issues are currently handled, and investigate and recommend strategies for heightening awareness and facilitating action on these issues.

IMPLICATIONS FOR TRAFFIC

As discussed in the preceding sections, increasing the use of public transit requires a significant improvement in the transit services currently being offered, while increasing bicycle commuting requires the creation of safer conditions for cyclists. Significant improvements in the surface component of the public transit system can be achieved by making more efficient use of the existing road space through transit priority measures. Such measures will, however, subtract from the road space available to private vehicles, given that the widening of existing roads is not an acceptable option. Creation of dedicated bicycle lanes will also subtract from the road space available to automobiles. Altogether, the space available to private automobiles on major roads could be reduced by 40-50%.

If increased traffic congestion is to be avoided, and in keeping with many of the measures which are proposed in this report, a corresponding reduction in private vehicle kilometres travelled within the city of Toronto is required. The desired outcome of the measures presented in this chapter, therefore, is a 50% reduction (from the 1990 value) in vehicle kilometres travelled (VKT) by private vehicles in the City of Toronto.

Although this outcome will in itself do much to contribute to achieving the emission reduction targets which are outlined in Chapter 2, (even though there may be a small increase in emissions associated with a greater number of public transit vehicles on the road), it is not an emission target per se. Rather, it is an outcome of a coherent strategy to improve the efficiency with which the existing (and fixed) road space is used, and will serve to enhance the quality of life for those living in the city of Toronto.

Recommendations: 19. That the City of Toronto recognize the need to reduce vehicle kilometres travelled in the city of Toronto by the year 2005 to the extent necessary to achieve the emission targets outlined above and to avoid an increase in congestion on the remaining road space available to automobiles, which could potentially offset emission reduction gains.

4. EXPANDING THE RAPID TRANSIT SYSTEM

During the 1950's and 1960's, Toronto developed a strong vision of its future which centred around building a fast, efficient rapid transit system, linking the city centre and the outlying areas and ensuring land use development was integrated with the rapid transit system. Substantial capital investment was put into expanding the public transit system. Over the past 30 years, Toronto has become a model for other cities wishing a better balance between public transit and automobiles (Kenworthy, 1989).

Nonetheless, after the 1960's, as the population and the economy continued to grow, investments in rapid transit came to a halt. Under today's tighter fiscal conditions, financing rapid transit expansions is a major issue. In the medium and long-term, several initiatives are necessary to help the transit system catch up with the extensive regional development that has taken place and to make it a more viable alternative to the car. These are:

encouraging better coordination of transit services, including linking all modes of travel.

securing right of way on the freight rail lines for rapid transit.

expanding rapid transit.

COORDINATING TRANSIT

The backbone of a long-term initiative to wean people from their cars in the Greater Toronto Area must relate to significant improvements in public transit including:

1. improvement of the existing surface transit system,
2. a rapid region-wide rail network between the suburbs and City Centre, which is linked to an expanded subway to serve the City Centre and other parts of Metro,
3. integration of all public transportation services in the Greater Toronto region in terms of fares, transfer points, planning and promotion,

Gateways, places where transportation facilities converge, providing opportunities for people to park their cars and continue their journey using rapid transit (GO Train, TTC subway), are ideally suited to carpooling. Examples of gateways include Yorkdale, Scarborough Town Centre, and the terminal points of the subway system at Finch and Kipling stations.

Subway
York Region
THE TORONTO SUN

Photo courtesy of GO Rail.

4. provision of adequate facilities for the speedy and convenient transfer of passengers from GO Transit to TTC vehicles and vice versa,
5. enhancement of parking facilities at suburban and Metro rail stations to allow motorists and cyclists to transfer to public transit rather than drive downtown,
6. coordination among all levels of government involved in transportation planning to permit integrated and well-funded expansion of the entire system.

The first point was dealt with in Chapter 3. This section will discuss points 3-6, and the rest of this chapter will cover point 2.

A coordinated plan to expand the transportation system in the GTA must begin by making improvements to the way in which the current transit systems are linked, and to the way in which the various transportation modes are interconnected.

Regional Coordination

There are a total of 14 separate transit operators in the Greater Toronto Area. What is required now is a system to ensure integrated planning and service provision across the region that will meet future transit needs.

In July 1986, the Ontario Minister of Transportation announced the formulation of the Transit Advisory Group (TAG) to study various options for improving the coordination of transit services in the GTA. The TAG was a diverse group comprised of academics, transportation planners, urban planners, consumer advocates and other professionals. Their work included a significant public consultation component.

In 1988, the TAG submitted their report, "Crossing the Boundaries", to the Minister with specific objectives, including:

- increased fare integration
- improved service co-ordination
- improved planning co-ordination

- improved co-ordination of transit services for disabled persons
- co-ordinated gathering, analysis and distribution of information on transit

Appendix 8 provides a full description of the report's recommendations. In addition to the objectives, the TAG recommended the establishment of an Inter-Regional Transit Co-ordinating Agency (ITCA) which would be responsible for advising the Minister of Transportation on ways to improve cross-boundary transit in the GTA (recommendation 2 in Appendix 8). In their response to the TAG report, GO transit and the TTC were fully supportive of all recommendations, with the exception of the creation of the ITCA. GO Transit and the TTC feel that the structure already exists within the Ministry of Transportation (MTO) to deal with inter-regional transit planning in the GTA. GO Transit and the TTC feel that the MTO should, as part of its mandate, internally undertake the responsibilities suggested for the ITCA, especially since the MTO funds the transit authorities now in operation and would be the primary source for the funding of such an agency.

While local transit authorities could continue to handle operations, significant service and planning co-ordination should take place at a regional level. This would help overcome conflicting policies and mandates and ensure system wide transit decision making. In addition, this rationalization of services would allow the system as a whole to become more cost-effective, therefore benefitting all residents of the GTA.

Such an approach is not new. The City of Munich, Germany initiated such a general transport plan in 1965 which created a region-wide rapid rail network with a suburban rapid railway and a new underground railway as well as a public transport authority to develop and administer an integrated system. The plan also improved traffic flow by concentrating it on urban expressways and minimizing traffic in the city centre (Meighorner, et al. 1984).

It is important that the recommendations which emerged from the TAG report be acted upon. Specifically for people who commute into the city of Toronto each day, improved integration between the GO and the TTC might induce a portion of these commuters to leave their cars at home.

GO/TTC Fare and Service Integration

Many residents of the Greater Toronto Area work in Metro (especially in downtown Toronto), and use GO Transit in combination with the TTC to travel to and from work. Both systems are part of the Greater Toronto Area transportation network and, as such, fare and service integration is not only desirable but necessary to ensure optimum service.

GO Transit and the TTC are currently undertaking a number of fare integration and service coordination initiatives. For example, the GO/TTC Twin Pass initiative is currently in effect. In addition, GO Transit is undertaking studies and projects concerning the physical interlinking of one system with the other, i.e. a direct passenger connection from GO Transit's Bloor rail station to the TTC Bloor/Dundas West subway station, and GO rail/TTC bus connection at GO's Weston rail station. Elsewhere, GO has fare integration with 11 of the 14 municipal transit properties operating in the Greater Toronto Area.

As well, Metro Planning is currently undertaking a study (Metropolitan Toronto Commuter Rail Station Location Study) to review commuter rail station locations within the boundaries of Metropolitan Toronto. There may be an opportunity for the TTC and GO Transit to achieve additional service integration at selected station sites.

Encouraging Bike and Ride Trips

Bicycles and transit complement each other. A strong bicycle-commuter population will strengthen the transit system. The 1989 survey of cycling enthusiasts revealed that bike commuters are twice as likely to choose public transit when they are not riding, than are cyclists who do not ride to work. In turn, a strong transit system provides an excellent foul weather alternative for cyclists.

According to the Washington based World Watch Institute, a 1983 study of American commuters revealed that just getting to public transit by bike instead of car would cut gasoline consumption for each commuter by almost 20% a year. Replacing a drive-to-work trip with a bike-and-ride trip would halve annual gasoline consumption for the average motorist.

The bicycle is already the fastest mode of transportation for short trips in the city. There is also an enormous potential for combining bicycles and public transit for longer trips because, with few exceptions, every city of Toronto resident lives within a ten minute bike ride of a subway station. The potential for combined bike-transit trips may be highest in the suburbs where feeder bus routes are generally not as frequent but the GO or TTC station is within easy cycling distance. In many European countries 10-55% of rail patrons arrive at the station by bicycle. European and Japanese experience shows that both bicycle and transit ridership can be increased by providing bike parking facilities at subway and train stations, providing bike routes to and from stations, and actively promoting combined bike-transit trips.

Recommendations:

20. That the City of Toronto urge the Ontario Ministry of Transportation, as part of its mandate, to internally undertake the responsibilities suggested for the proposed Inter-regional Transit Coordinating Agency outlined in the recommendations of the Transit Advisory Group report (Appendix 8).
21. That the City of Toronto fully support the Ontario Ministry of Transportation in pursuing the objectives outlined in recommendation #1 of the Transit Advisory Group report (Appendix 8).
22. That the City of Toronto request that GO and TTC investigate the potential for further physical integration of transit services at all GO rail stations within Metropolitan Toronto.
23. That the City of Toronto encourage the TTC and GO Transit to provide secure, covered bike parking at all subway and GO stations, convenient routes to and from stations, and to aggressively promote combined bike transit trips.
24. That the City of Toronto fund a pilot project in conjunction with the TTC to demonstrate the potential of bike-and-ride trips.

EXPANDING GO SERVICE

The existing rail infrastructure within the City and Metro provides the opportunity to develop and expand upon the existing GO service at a lower cost and within a shorter time frame than it would to construct new routes.

A truly inter-urban passenger rail system is needed that makes greater use of the existing tracks that now primarily carry freight.

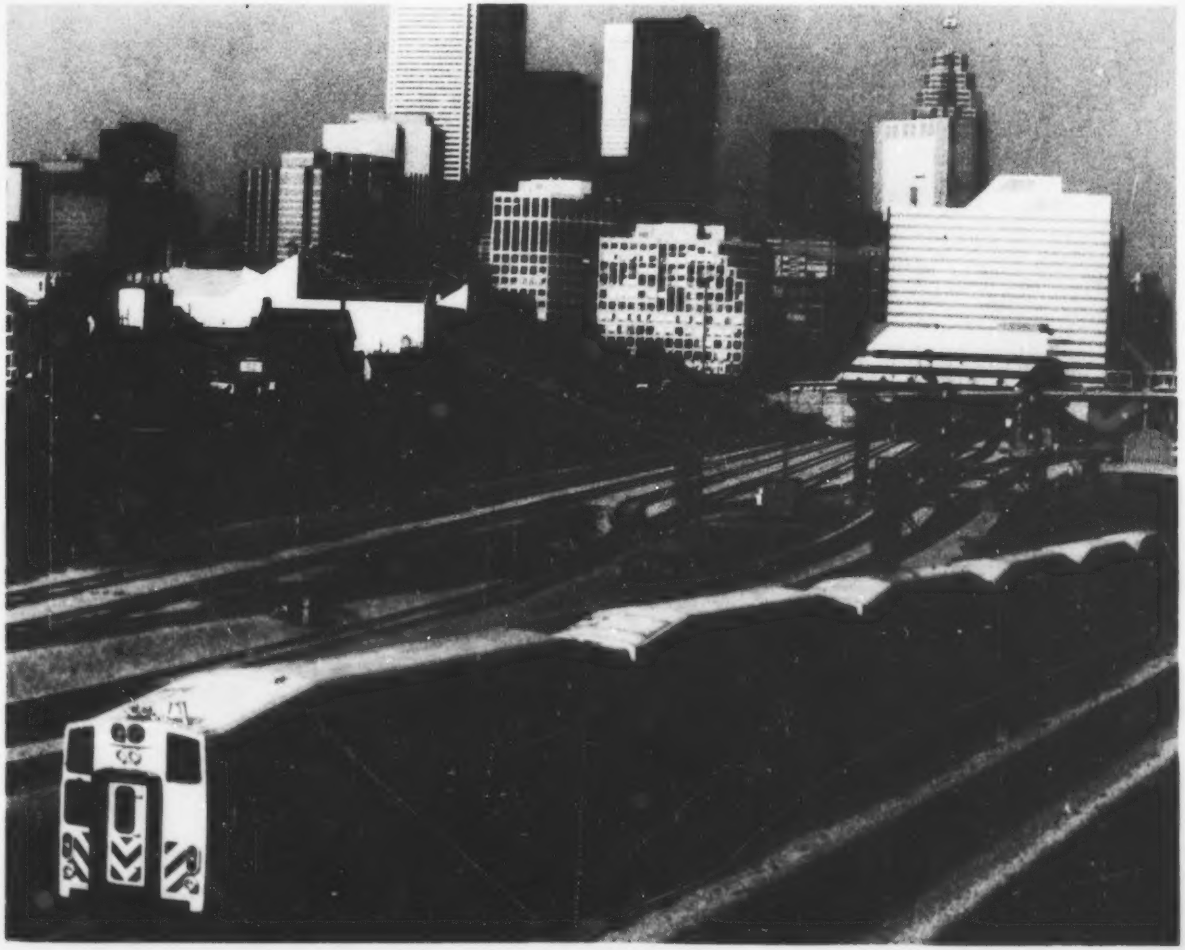


Photo courtesy of GO Rail.

The long term goal should be the utilization of many, if not all, of the rail corridors in the Municipality of Metropolitan Toronto for rapid transit use. At the same time, the existing rail freight traffic network would have to be rationalized in conjunction with CN or CP Rail. This rationalization of the rail freight network within Metropolitan Toronto (part of the Ontario, Canadian and North American network) would have to be undertaken in a way that would not substantially affect Greater Toronto Area economic development objectives nor seriously impair the ability of the Ontario rail freight network to accommodate national environmental objectives, such as mode shifting for energy efficiency reasons, and national/provincial economic productivity objectives, such as avoiding increasing road congestion for trucks.

Metro Councillor Dale Martin, and others, have developed proposals recommending:

1. the removal of dangerous cargo and regular freight traffic from the North Toronto (Dupont St.) CPR line and the introduction of GO service on the line, with subway connections at Summerhill and Dupont Stations. (The Summerhill Station already has a connection to the TTC);
2. the introduction of regular day-long GO service, with 15 to 20 minute headways on the CNR line of the Weston subdivision in the west, together with one of a number of other lines east of Union Station (i.e., Bala or Uxbridge hub of the CNR or one of the two CPR lines). This option produces a rapid rail line to Pearson Airport, rapid transit service to the City of York, Northern Etobicoke, and potentially to Jane/Finch. Depending on the route chosen, to the east it could mean rapid transit links to the Science Centre and the Zoo in the near future.

Recommendations:

25. That the City of Toronto support the long term goal of utilizing many, if not all, of the rail corridors in the Municipality of Metropolitan Toronto for rapid transit use in accordance with GO Transit's long term service strategy (see Appendix 9).
26. That the City of Toronto urge the Ontario Ministry of Transportation to undertake freight rationalization network studies within the Greater Toronto Area in conjunction with CN and CP Rail.

EXTENDING RAPID TRANSIT: A PROPOSAL

While there is no set definition for 'rapid transit', the term generally refers to subways and right-of-ways, and excludes surface transit priorities.

Rapid transit investment in Metro Toronto in the 1980's slowed considerably from previous decades (Exhibit 9). During the 1980's, the only expansions to the rapid transit system were the extension of the Bloor-Danforth line, and the opening of the Scarborough Rapid Transit line. These projects added 10.7 kilometres of new rapid transit lines, and with the opening of the Harbourfront LRT in 1990, the total TTC rapid transit network is currently 64.4 kilometres. The relative decline in the lack of rapid transit infrastructure investment in the 1980's occurred during a time when demands on the system increased dramatically, with TTC ridership growing by 23% from 1980 to 1989.

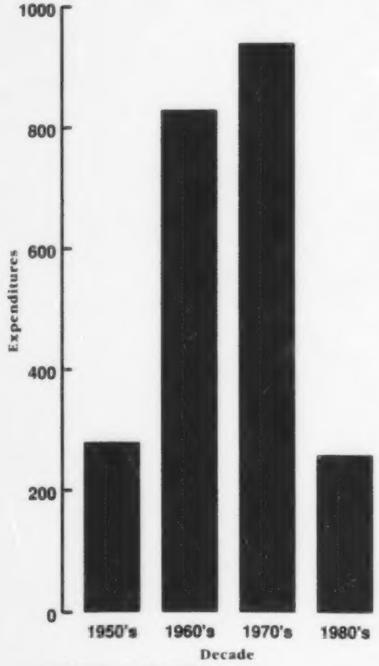
In April 1990 the Province of Ontario made a $5 billion commitment to rapid transit expansion in the GTA over the next 10 years through the "Let's Move" program. In November 1990, the current provincial government adopted most of the "Let's Move" plan, with some possible modifications, and proposed some additional expenditures including $70 million over the next five years towards improving TTC maintenance and operations.

However, given the lack of transit infrastructure investment in the 1980's, the "Let's Move" announcement and the increases proposed by the NDP, are, in effect, "catch up". In fact, in responding to "Let's Move", Metro Council endorsed the plan as a short-term start in satisfying the rapid transit needs of only Metropolitan Toronto. Because rapid transit is the backbone to a successful transit system, the Province will have to commit substantial funding to rapid transit in the near future in order to maintain and enhance transit as a viable transportation option to the private automobile, and to reverse the trends of increasing vehicle kilometres travelled, vehicle emissions, and congestion.

The specific location of future rapid transit expansions will depend to a large degree on the outcome of discussions on the potential urban form in the GTA. Recently, the IBI Group (1990) prepared a report entitled,

EXHIBIT 9

TTC EXPENDITURES ON RAPID TRANSIT* (MILLIONS OF 1985 $)



***Subways and LRTs**

Source: TTC

EXHIBIT 10

PROJECTED GROWTH IN TRANSIT AND AUTO USAGE TO THE YEAR 2021

	Peak Period Public Transit Ridership	Associated Public Transit Capital Expenditures (billions)	Increase in Peak Period Automobile Kilometres Travelled	Associated Capital Expenditures on Roads	Total Transportation Investment (billions)
Spread(1)	26%	$7.2	83%	$20	$27.2
Central(2)	35%	$14.4	44%	$13	$27.4
Nodal(3)	29%	$11.6	65%	$17	$28.6
Current	26%				

(1) urban sprawl continues unchecked

(2) new population is placed within existing urbanized areas

(3) greater expansion of urbanized area than central, but concentrated at a number of nodal centres

Source: IBI Group 1990

Greater Toronto Area Urban Structure Concepts Study, on behalf of the Greater Toronto Coordinating Committee. This report examined three alternative modes of growth, over the next 30 years, in the Greater Toronto Area (GTA): (1) Spread, in which present urban sprawl continues unchecked; (2) Central, in which new population is placed within the existing urbanized area to the extent that this can be cone without redeveloping existing stable residential neighbourhoods; and (3) Nodal, in which greater expansion of urbanized area occurs than for Central, but concentrated at a number of nodal centres. The Metro Toronto Planning Department has considered two further alternatives, dubbed Fingers and Reinvestment. All these scenarios assume the same growth in population and employment: 6 million in the GTA by 2021.

Exhibit 10 outlines the expected growth in transit and auto usage which would occur under each scenario and their associated costs. Each of these scenarios has specific implications for the nature and extent of future rapid transit requirements. The three scenarios require roughly the same dollar investment for the total cost of transportation, both roads and public transit. This indicates that no option is more expensive than the other, but rather that the basis for allocation of dollars to either public transit or roads is one of government priorities, not cost.

In addition, under all three alternative scenarios, there remain huge increases in traffic to be absorbed on the roads. Even under the Central scenario, a 44% increase in peak automobile-kilometres is projected for the period 1986-2021. However, with the full set of proposals in this report, automobile dependence in the GTA could be decreased.

An example of the magnitude of a future rapid transit network required to meet increasing transportation demands and to address associated environmental problems is given in Appendix 10.

The important principles which should guide any rapid transit expansion are:

1. to build network flexibility;
2. to build a comprehensive grid of rapid transit lines;
3. to build in links with transit systems outside Metro Toronto; and

4. to provide convenient access to the major institutions such as the airport and York University.

Subways cost about $100 million per kilometre, and the extensions discussed in Appendix 8 amount to 140 km, giving a total cost of about $14 billion. If built over a period of 15 years, this would cost just under $1 billion per year, at current prices. However, not all of the transit lines in a comprehensive rapid transit system need be subways, in which case the cost would be less.

Neither the "Let's Move" program with 5 billion dollars towards public transit over the next 10 years, nor the IBI study which suggests $7-14 billion over the next 30 years are sufficient to meet future transportation demands of a less automobile dependent society. Over the next 15 years, it is necessary to invest sufficiently in the public transit infrastructure to provide the services which allow the GTA to become less automobile dependent.

Recommendations: 27. That the City of Toronto urge the Province of Ontario to increase spending on rapid transit to enable significant, comprehensive expansion of the rapid transit system in the Greater Toronto Area as soon as possible.

FINANCING PUBLIC TRANSIT EXPANSION

As noted in the previous section, a substantial increase above the total cost of the "Let's Move" plan will be required over the next 10-15 years if the public transit system is to compete with the private automobile as a means of transportation. This could require investments in the order of $1 billion a year for the next 15 years. Although this is a large sum in absolute terms, it is small relative to other expenditures currently going on, such as supplying electricity to Ontarians over the next 25 years ($60-200 billion) and the estimated cost of congestion to commercial activities in Metropolitan Toronto of $1.7 billion per year, or the Gross Provincial Product of $160 billion/year (1990).

There are a number of mechanisms through which the necessary transit funds could be raised, and a number of jurisdictions under which these revenues can be collected. Currently, the Toronto Transit Commission capital costs are met with 75% from provincial tax revenues and 25% from Metro general tax revenues.

The federal and provincial governments should impose a carbon tax on operators of petrol powered vehicles and owners of industries which burn fossil fuels to help pay for related environmental clean-ups. Revenue from this new tax should also support the development of public transit and the application of alternative fuels.

Photo by Vince Pietropaolo

At its meeting of August 13 and 14, 1990, City Council adopted a report entitled "Funding of Major Toronto Transit Commission Capital Projects". The report discussed four potential funding sources: variations on the current taxation structure; application of the Development Charges Act (Bill 20); density bonusing and equity investment (or joint venturing) strategies. City Council rejected the use of the density bonusing as a means to secure funds for public transit because it was felt "the double objectives of addressing the City's current housing shortage and reducing the need for major Central Area transportation improvements" could best be met by allowing bonusing in exchange for the provision of social housing, which has largely been the current City practice.

In September 1989, the Metro Task Force on Financing Infrastructure Capital Expenditures was established to discuss, identify and study potential sources of revenue to finance the future Metropolitan Toronto capital program. The City provides feedback into this process. Approximately 36% of Metro's infrastructure capital expenditures over the next ten years would go to public transit. Currently, the Task Force has adopted a set of "First Principles" to provide a policy framework against which to evaluate joint public-private ventures, and has submitted its first discussion paper (February 25, 1991) on possible financing instruments. In this discussion, the Metro Task Force recommends that the application of the Development Charges Act not be pursued as a source of revenue. It was concluded that the Act's "... weakness as a financing instrument coupled with the legislations' inherent complexities make it an undesirable tool for this (i.e. Metro) level of government" (p.10). The Task force went on to identify other preferred financial instruments and, among other things, recommended that Metropolitan Council:

(a) hire a consultant to carry out a detailed study of the five selected financial instruments discussed in the report: special rates and charges, by which local municipalities can levy charges against existing properties to finance additional capital facilities or improve facilities; density bonusing, either at the Metro level or the possibility of Metro sharing in the local benefits; land value capture strategies, because land values increase when nearby transit facilities are improved; contributions from bordering regional governments and connecting fees to subway stations;

(b) establish a Metro Sheppard Subway Finance Steering Committee with politicians and staff to develop a framework to finance specifically the Sheppard Subway.

At the provincial level, the Transit Implementation Group (T.I.G.) sub-group on financing has been established to develop proposals for the technical and financial means to implement the "Let's Move" program.

Both of these committees, however, are working with the financial objectives identified in the "Let's Move" plan. Additional financial objectives, such as those identified in the previous section, could require additional sources of funding. If road pricing were to be introduced in the long term, this would provide a potentially major source of funding not currently under consideration. This possibility would have to be examined as part of the study on road pricing which is proposed in Section 5.5. Another significant source of funding, which would be best administered at the provincial level, would be a gasoline and/or carbon tax dedicated to public transit.

Transit Tax on Gasoline:

Currently, both the provincial and federal governments impose taxes on gasoline. In 1990, this amounted to 11.3 cents per litre in Ontario and 12.3 cents per litre at the Federal level for unleaded gasoline. In 1991, the G.S.T. was added. Designating a set proportion of these revenues to transit could offset the costs of expansion, particularly if an increase were added.

At the gas pumps, additional taxes on gasoline could be implemented gradually in conjunction with mandated increase in automobile fuel efficiency so as to offset any financial hardship on poorer members of our society who may have to use their automobile. In addition, it is important to prevent the cost required to drive a given distance from falling as automobile fuel efficiency improves. Ideally, increasing gasoline taxes, a revenue-neutral system of surcharges and rebates on the purchase of less and more efficient vehicles than the average, respectively, and improving fuel efficiency standards should be part of an integrated strategy.

Increasing gasoline taxes in the short-term to provide funding which could be used for rapid transit improvements, could lead to equity problems. Poorer people, for instance, spend a much greater percentage of their income on fuel than the rich and are therefore penalised by a flat tax on gasoline. People in rural areas, who do not benefit from public transit, could also be adversely penalised.

As a result, it is necessary to consider whether mechanisms can be found to decrease the negative social effects of the gas tax. The most obvious option for compensating low income people for the effects of the proposed tax is to make available a gas tax credit through the income tax system. Because of the difficulty of determining who owns a car or whether they use it, it may make sense to compensate everyone below a certain income level. This would also have other benefits. For instance, if low income drivers then wished to switch to a more fuel efficient vehicle or to take transit where possible, it would put more money in their pockets to do so.

In light of the difficulties to be expected in the implementation and administration of a flat rate gas tax, it may be more useful to consider the idea of a more broadly based tax such as a carbon tax or green tax which would include, but not be limited to gasoline. This type of tax would have the advantage of being less discriminatory and could also be used as a way of incorporating the costs of environmental damage in the price of fuel. Such a tax could reduce travel demand and hence energy use and emissions.

A more practical option in the short-term might be to increase the amount of excise tax on gasoline in direct proportion to the increase in Corporate Average Fuel Economy (CAFE), i.e. as the carbon tax is phased in. In this way tax revenue which could be used for transit would increase while the cost to drivers, per kilometre travelled, would remain the same. One drawback might be the fact that with no increase in the cost of driving, people may not reduce driving and the trend to increased car use may continue.

Both the federal and provincial governments have the jurisdiction to impose taxes or measures that would reduce use of carbon-based fuels as well as the ability to regulate such matters. For example, the Fuel Tax Act could be used to achieve a carbon release surcharge in Ontario and with enabling legislation the province can create a carbon release compensation fund which could be used in part to finance public transit. In addition, vehicle owners could be required to have vehicles inspected for a fee and this fee could go into a specific fund.

This would require only minor amendments to the Highway Traffic Act. At the federal level, the Excise Tax Act could be used to collect further consumption taxes on fossil fuels.

Finally, in order to make the tax measure effective in this context, the federal and provincial governments would have to agree to dedicate the additional monies to public transit.

In conclusion, because public transit infrastructure expansion is required throughout the GTA, because the Province remains the major source of funding for large scale expansion projects, and because the application of several financial instruments may require amendments to Provincial legislation, the Government of Ontario must play an active role in bringing the affected municipalities together to discuss financing options which will be beneficial to the public transit system in the GTA.

Recommendations:

28. That the City of Toronto urge the Government of Ontario to take immediate measures to protect potential rapid transit corridors in the GTA while the necessary capital funds are being raised. This can minimize the eventual costs of expanding the rapid transit infrastructure.
29. That the City of Toronto request that the Government of Ontario investigate a system whereby revenue generated by the various options under consideration by Metro, and/or a carbon tax, can be dedicated to transit subsidies.
30. That the City of Toronto and the Provincial government investigate a new formula for taxing gasoline which will tie the tax rate to the Corporate Average Fuel Economy (CAFE).
31. That the City of Toronto urge the Governments of Canada and Ontario to each use their existing regulatory powers to establish a carbon release surcharge fund as soon as possible and that these monies be dedicated towards transportation alternatives to the automobile, including public transit.
32. That the City of Toronto request the Federal Government to investigate the structure and administration of a manufacturing tax designed to incorporate the cost of environmental damage into the price of fuel.

5. LIMITING VEHICLE EMISSIONS

Air pollution levels in the City of Toronto have remained stable over the past 10 years at levels below the allowable criteria. However, there have recently been many episodes in which ozone and other pollution levels have exceeded the criteria for both the one and eight-hour period.

In addition, internationally, the city rates among the highest for nitrogen dioxide (NO_2) and carbon monoxide (CO). Exhibit 11 provides an international comparison of the nitrogen dioxide and carbon monoxide levels in world cities, and their relationship to the World Health Organization guidelines. At particularly critical pollution episodes, levels in Toronto have exceeded the WHO guidelines for NO_2 and CO. These maximum levels are more significant than the annual averages because these levels show the incidence at which people are at a health risk (UNEP and WHO 1988).

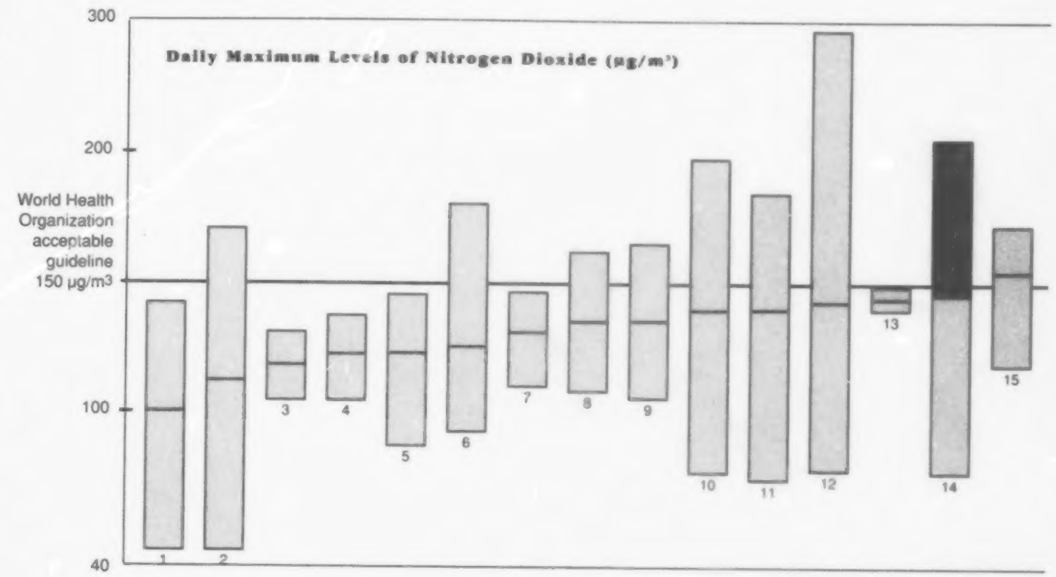
Exhibit 12 provides a summary of pollutant levels in Toronto and Ontario over the past decade. Exhibit 13 provides the emission inventory for these pollutants in Metro Toronto and highlights the contribution of the automobile to the total pollutant load. Several important facts emerge from these figures:

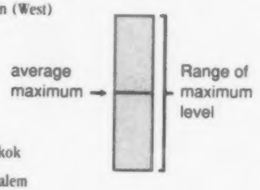
- Carbon monoxide levels in Toronto today are approximately 30% lower than they were 10 years ago. In 1988, however, there were six 8-hour periods when the levels exceeded the maximum allowable.
- Nitrogen dioxide levels in Toronto's air today are very much the same as 10 years ago. Over the past 2 years, NO_2 levels have not exceeded even the maximum desirable level.
- Hydrocarbon levels in Toronto are approximately 50% higher today than 10 years ago.
- Although average ozone levels in Toronto have remained roughly constant during the past 10 years, the allowable one hour level was exceeded 26 times in 1989 (110 times in 1988) at the Breadalbane Station, and 265 times in 1989 (373 in 1988) at the CN Tower Station. These are summertime episodes, during which time those who are most susceptible experience respiratory problems.

EXHIBIT 11

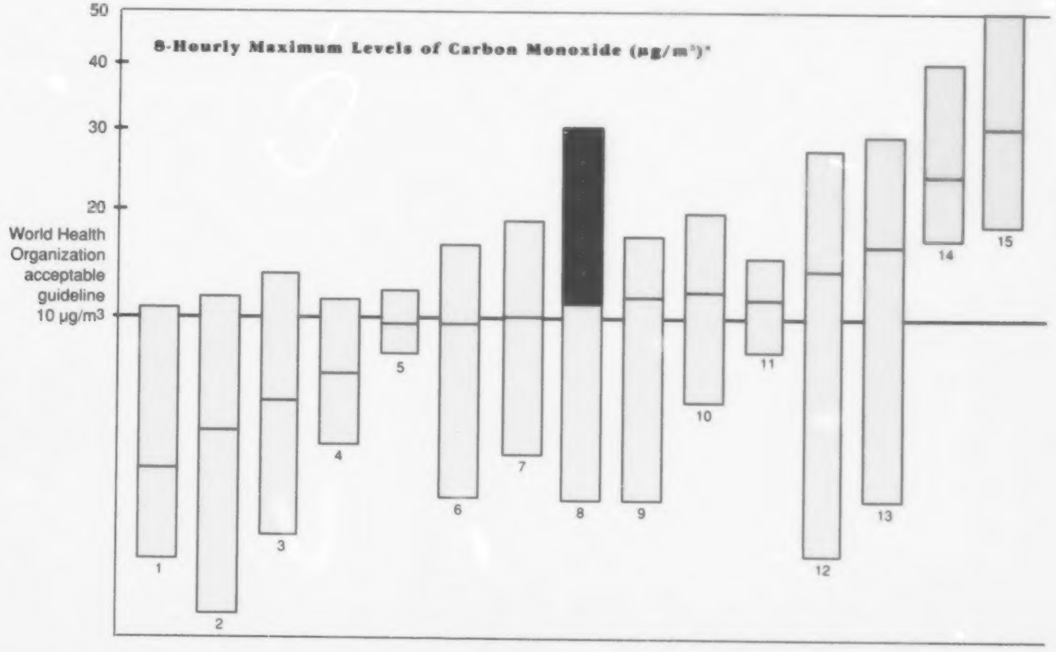
POLLUTION LEVELS IN CITIES AROUND THE WORLD

1. Bombay
2. Craiova
3. Frankfurt
4. Amsterdam
5. Brussels
6. Vancouver
7. Cologne
8. Antwerp
9. Jerusalem
10. Hong Kong
11. Bucharest
12. Montreal
13. Rotterdam
14. **Toronto**
15. Berlin (West)





1. Bangkok
2. Jerusalem
3. Cubertilo
4. Houston
5. Tel Aviv
6. Montreal
7. Vancouver
8. **Toronto**
9. Chicago
10. New York
11. Melbourne
12. Los Angeles
13. Sao Paulo
14. Brisbane
15. Paris

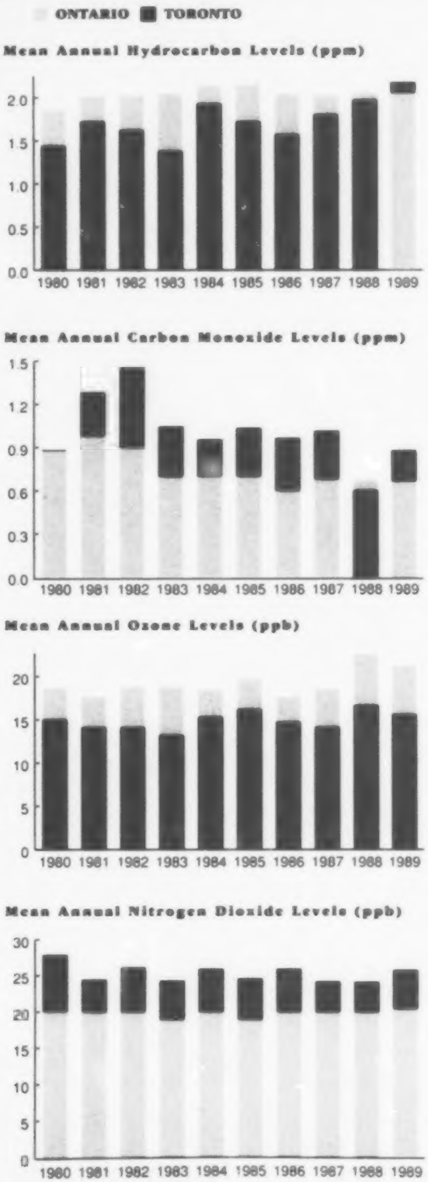


*note logarithmic scale

Source: WHO and UNEP 1988

EXHIBIT 12

10 YEAR POLLUTION TREND IN ONTARIO AND TORONTO*



*Testing at 26 Breadalbane Station

Source: Ontario Ministry of the Environment 1991

In 1988, Southern Ontario, including Toronto, experienced peak ozone concentrations exceeding maximum acceptable levels. While there was an important local contribution (35%) in Toronto to the observed pollution, about 70% was due to American sources. In general, 50-60% of ozone in Southern Ontario comes from the U.S., not including ozone formed here due to precursors originating in the U.S. (Yassi, 1990). With an increasing number of vehicles entering the city, the frequency of critical episodes can be expected to increase, especially during hot summers. Steps must be taken to minimize their occurrence.

Air quality readings by the Ontario Ministry of the Environment in the city are taken at stations which are above street level, in locations which may not represent 'real' exposure conditions. Currently, the Environmental Protection Office of the city of Toronto is undertaking a study of pollution levels at "nose" level. This will give a better estimate of what people are exposed to at street level. Further testing for this study will likely be undertaken in the summer of 1991, with the results forthcoming.

In addition to the above air pollutants, the Greater Toronto Area (GTA) is also a significant source of carbon dioxide (CO_2). As Exhibit 5 shows, on-road transportation accounts for about 25% of national and provincial emissions.

Four approaches to limiting vehicle emissions are discussed further in this chapter:

1. greater enforcement of current provincial and federal emission standards;
2. strengthening the federal and provincial emissions and fuel economy standards;
3. implementation of traffic management plans at the municipal level to reduce emissions; and
4. supporting research, development and demonstration of alternative fuels at all levels of government.

RAISING EMISSION STANDARDS

Since 1987, Canadian emission standards for light duty vehicles have matched those of the "49 State" emission standards, in force in the United States since 1987. On February 17, 1990, the Canadian government announced a plan to consider the implementation of stricter emission standards for motor vehicles by 1994. By 1994/1995, they expect to match those which will be in force in California by 1995, the strictest in North

As a result of
improved fuel
efficiency, cars will
require fewer
fill-ups. This in
turn will reduce
harmful tailpipe
emissions.

Canapress photo.

EXHIBIT 13

METRO TORONTO TOTAL EMISSION BY SECTOR 1988 (tonnes)

Sector	NOx	Particulates	CO	VOC
Total vehicle	59267(73%)	8131(28%)	422454(88%)	53566(35%)
Residential	3964(5%)	10288(36%)	4122(9%)	7171(5%)
Industrial	1948(2%)	3189(11%)	*	*
Other Sources (incineration off road engines aircraft & other)	16250(20%)	7151(25%)	14430(3%)	91396(60%)[1]
Total	81250	28605	481001	152327

* Less than 1%

(1) 95% attributable to VOC evaporative processes (solvent use etc.)

Source: Ministry of the Environment of Ontario 1989

America. Exhibit 14 outlines the current and proposed standards for HC, CO, NOx, SP and CO_2. According to Environment Canada, these new standards would aim for a 60% reduction in NOx and a 29% reduction in CO. Exhibit 15 shows the decrease in automobile emissions levels which could be achieved in Toronto with the adoption of these standards.

These standards apply only to new vehicles. It is estimated, however, that 50% of the air pollution problem is caused by 10% of automobiles. These are mostly older cars with aging parts. This presents a significant problem because provincial law does not allow retro-fitting.

Recommendations:

33. That City of Toronto indicate to the Government of Canada that it fully endorses the adoption of the California standards for automobile emissions by 1994.
34. That the City of Toronto urge the Government of Ontario to allow the retro-fitting of older cars which seek to improve fuel efficiency and decrease emission levels.

TESTING VEHICLE EMISSIONS

Although the setting of vehicle emission standards is a federal and provincial responsibility, it is within the jurisdiction of municipalities to enforce these standards. This, however, is not being done at present. Enforcement could take the form of periodic, universal vehicle emission testing, or random spot checking using newly emerging technologies, or some combination of the two.

During the week of 23 April 1990, the City of Toronto and the Ontario Ministry of the Environment tested a device developed at the University of Denver for sensing emissions from automobiles on freeway on/off ramps. The device consists of an infrared radiation source on one side of the on/off ramp and a sensor on the other side. As cars pass the infrared beam between the source and sensor, the carbon monoxide (CO) and carbon dioxide (CO_2) concentrations in the exhaust gas can be determined. In a vehicle with perfect fuel combustion, no CO would be emitted. If the CO/CO_2 ratio exceeds some specified value, a camera can be triggered to photograph the license plate of the offending vehicle, and the owner notified and required to take corrective action.

Data collected in Toronto indicate that 10% of the vehicles on the road are responsible for 50% or more of total

EXHIBIT 14

CURRENT AND PROPOSED LIGHT-DUTY VEHICLE EMISSION STANDARDS IN CANADA[1]

	Exhaust Emissions (g/km)				
	HC or OMHCE[2]	**CO**	**NO_x**	**SP**	**CO_2**
Current	0.25	2.04	0.6	0.12	-
Proposed	0.15[3]	2.04	0.24	0.05	192[4,6] 250[5,6]

(1) In addition to the levels above, no crankcase emissions are allowed.

(2) The HC level applies to non-oxygenated hydrocarbon fuelled vehicles while the Organic Material Hydrocarbon Equivalent (OMHCE) level applies to oxygenated-fuelled vehicles.

(3) Non-methane hydrocarbons.

(4) This level may be met on an individual vehicle or company average basis.

(5) This level may be met on an individual vehicle or company average basis and applies to the 2005 and later model years.

(6) These levels are equivalent to the Corporate Automobile Fuel Economy (CAFE) standards which are discussed in Chapter 5.

Source: Environment Canada 1991

EXHIBIT 15

PROJECTED LIGHT DUTY VEHICLE EMISSION LEVELS IN TORONTO WITH THE INTRODUCTION OF THE CALIFORNIA STANDARDS IN 1993/1994

	Exhaust Emissions (g/km)		
	NO_x	**CO**	**Hydrocarbons**
Current Fleet	1.28	17.0	2.11
Year 1995	0.82	11.88	1.46
2000	0.53	10.4	1.16
2005	0.43	10.1	1.10
Electricity from coal	1.24[1]	negligible	negligible
Streetcar	3.75	negligible	negligible

(1) Assumes low NO_x burners on all thermal plants, as recently installed at Nanticoke.

Source: Environment Canada 1991a
Special Advisory Committee on the Environment 1991

carbon monoxide (CO) emissions. If these vehicles can be routinely detected through a series of mobile detectors, this may provide a relatively inexpensive means of eliminating a large fraction of CO emissions.

In response to the April demonstration, the Ontario Ministry of Environment has issued a request for proposals to develop a mobile system capable of measuring hydrocarbon, as well as CO, emissions. A capability to measure NOx emissions is also desirable.

Recommendations:

35. That the City of Toronto urge the Government of Ontario to systematically enforce the current emission standards, and that penalties imposed be strict enough to encourage compliance.
36. That the City of Toronto reiterate to the Province of Ontario its interest in the commercial development of mobile detectors capable of measuring pollutant emissions from automobiles, and its willingness to assist the province in the establishment of a network of such detectors to the extent that it includes roads controlled by the City of Toronto.
37. That the City of Toronto urge the Province of Ontario to require periodic emission testing of all road vehicles in conjunction with annual license renewal.

STRENGTHENING FUEL ECONOMY STANDARDS

A recent U.S. study (ACEEE, 1990) indicates that the average fuel economy of new automobiles manufactured in the U.S. could be increased from its present value of 27.5 mpg to 43 mpg with no change in the proportion of cars sold in each size class, simply by making use of all currently available new technologies. Given the integration of Canadian and American automobile industries and the fact that the Canadian fleet also averages 27.5 mpg, similar improvements should be readily achievable in Canada. Given further technological development and some shift from large, high-powered cars to smaller vehicles, a fleet average of 50 mpg by the year 2000 could be achieved. Various analyses have shown that such an improvement is economically attractive even at pre-Persian Gulf Crisis gasoline prices (Goldemberg et al 1988).

Light trucks are now a popular alternative to the automobile for private use. However, the CAFE (Corporate Automobile Fuel Economy) standards, the fuel efficiency standards for vehicles, in both the U.S. and Canada apply only to automobiles, not to light trucks. As well, commercial transportation accounts for significant energy use. It is therefore important that efficiency improvements and emission standards be mandated for light and heavy duty trucks as well as for automobiles.

Financial incentives could induce people to buy more fuel efficient cars. For example, a surcharge could be applied, at the time of purchase, on cars and light duty trucks which are less efficient, and rebates on cars and trucks which are more efficient. For light duty trucks purchased by businesses, the magnitude of the surcharge or rebate could be tied to the average fuel economy of light-duty trucks alone, rather than based on the combined automobile light-duty truck average.

Recommendations: 38. That the City of Toronto use every opportunity to urge the Provincial and Federal levels of government to:

- (a) implement a transition from the present CAFE standard of 27.5 mpg to 50 mpg (4.6 litres/100 km) by the year 2000;
- (b) develop and implement standards for efficiency improvements among light and heavy duty trucks as high as is technically achievable;
- (c) impose a revenue-neutral system of sliding surcharges and rebates designed to encourage consumers to purchase the most energy-efficient automobiles and to discourage purchase of light-duty trucks in place of automobiles for private use.

USING ALTERNATE FUELS

The use of non-petroleum fuels to reduce pollution from motor vehicles is receiving increasing support from those who are concerned for the environment, as well as those directing the automobile industry. A recent bill in the U.S. was passed to encourage automobile manufacturers to produce "dedicated" alternative fuel vehicles or fuel "switchable" vehicles. Dedicated alternatives imply a fuel with greater than 85% volume of methanol or ethanol. Fuel switchable vehicles are capable of operating on various blends of petroleum and gasoline fuels, or of operating on gasoline and natural gas.

The TTC is experimenting with natural gas powered buses in an effort to reduce diesel emissions from its vehicles.

POWERED BY CLEAN NATURAL GAS

Photo courtesy
Ministry of Transportation.

Exhibit 16 provides a summary of the advantages and disadvantages of the six available alternatives to gasoline. Appendix 11 outlines in detail the current status of alternative fuels. Below is a brief summary of the current status of available alternative fuels.

Recent evaluations of air quality emissions from alcohol-fuelled vehicles suggest a wide range of results. Considerable controversy exists on alternate fuel use, especially with respect to methanol fuelled vehicles. Pure methanol emits very limited amounts of hydrocarbons, but it does not offer much benefit in terms of carbon emissions. If methanol is blended with gasoline, carbon monoxide emissions can be reduced, but the ozone benefit is also diminished. Methanol fuels do, however, produce less carbon dioxide than gasoline fuels. Yet if the methanol is produced by converting coal into methanol, a doubling of the total carbon dioxide emissions is anticipated (Ross, 1990). Colorado and certain other U.S. states are implementing measures to encourage use of mixed fuels, with up to 10% ethanol or methanol. California is also encouraging the use of pure methanol fuel because it reduces hydrocarbon emissions and therefore reduces ozone pollution at ground level.

Natural gas-powered vehicles emit less carbon monoxide and soot than gasoline powered vehicles, but produce more oxides of nitrogen, and barely reduce carbon dioxide emissions.

Electric vehicles essentially emit no pollutants at the point of use. However, the electricity to power them must be produced somewhere. If this involves coal combustion, the emission of carbon dioxide would remain or could even be aggravated. Rather than pollute the city, these emissions would affect another part of the province or country.

In the longer term, the most environmentally desirable fuel of the future may be hydrogen. It does not create carbon dioxide, carbon monoxide or hydrocarbon emissions, and emission of the oxides of nitrogen are low to zero depending on how it is used. There are three major considerations in the use of solar hydrogen as a transportation fuel: the energy source; onboard storage, and the choice of energy conversion technology.

EXHIBIT 16
FIVE ALTERNATIVE FUELS

Ethanol	
Advantages: •High Octane •Renewable resource (made from corn and biomass) •Produces less CO_2 than gasoline does per kilometer, but total CO_2 impact depends on distillation process and efficiency of growing crops •As a gasoline additive, it lowers CO emissions	*Disadvantages*: •Less energy per litre •Expensive •As a gasoline additive, it may promote the formation of smog
Electricity	
Advantages: •Virtually no emissions from the car itself	*Disadvantages*: •Emissions including electricity production could result in higher emissions overall •Current technology limits speed to 50-100 km per hour, recharge at 6-8 hours and vehicle range to 96-160 km per charge
Hydrogen	
Advantages: •Renewable energy source •Virtually no emissions from the vehicle itself	*Disadvantages*: •With current technology, very energy intensive to produce, yielding net energy loss •Currently high carbon emissions during production •Currently difficult to store on-board vehicle •'Ideal' technology, mitigating current disadvantages, unlikely to be available for at least 20 years
Methanol	
Advantages: •High octane •Hydrocarbon emissions are 85-90% lower than for gasoline •Produces less CO_2 than gasoline when burned, but total CO_2 impact depends upon method of production •Much higher efficiency in the engine than gasoline •Liquid, therefore easy on-board storage	*Disadvantages*: •Carbon based, therefore finite •High methane leakage during transportation •Higher CO_2 emissions than for gasoline if manufactured from coal •Large storage volume required
Natural Gas	
Advantages: •Abundant fuel supply •Currently inexpensive •Hydrocarbon emissions are 40-90% lower than for gasoline •CO emissions are 50-90% lower than for gasoline •CO_2 emissions are 10% lower than for gasoline •Distribution system largely in place	*Disadvantages*: •Carbon based, therefore finite supply •Methane leakage during transportation •Greater NO_x emissions than for gasoline •Cumbersome fuel tank •Requires refueling every 160 kilometers •Refueling is 2-3 times longer than for gasoline

Sources: Consumer Reports January, 1990; Municipality of Metropolitan Toronto, 1991

These are discussed in Appendix 11. The best prospects for the use of hydrogen, economically and technically, are for transportation applications in buses or locomotives rather than as a fuel for private automobiles.

Alternative fuel technologies if introduced now will require adaptation of existing vehicles until newly designed vehicles become available. Currently, alternative fuel demonstration programs are in place in North America and manufacturers are developing prototype vehicles.

The Purchasing and Supply Department of the City of Toronto is currently involved in the following initiatives:

(a) One City fleet car has been converted to dual fuel (natural gas and gasoline), and its performance is being studied.

(b) The Standardized Vehicles Specifications book for use by Metropolitan Toronto Departments has been revised as an option to all departments.

(c) A quotation will be issued for six City garbage packers fuelled by dedicated (non-dual fuel) natural gas engines.

(d) An electric powered van is on order.

(e) Purchasing and Supply Department attempted to order six pick-up trucks with dedicated natural gas engines. However, the current production run of these vehicles has been assigned to a program in the U.S.A. and no additional vehicles are presently available. Consequently, two of the existing pick-ups will be converted to natural gas as dual fuel vehicles, and the Department will attempt to purchase dedicated natural gas light duty vehicles in 1991.

(f) A methanol-fuelled car is being purchased for Metro Toronto and the City Purchasing Department will share in information acquired from its use.

(g) The Purchasing Department has requested pricing for gasohol (as described by Environment Canada - Environmental Choice Guideline). Bidders did not quote on this product and supplied pricing for unleaded gasoline only. The product is not commercially available due to the high cost of ethanol.

Considerable research is still needed to solve the technical and cost problems of all the potential alternative

SWITCHED onto ELECTRIC POWER

The City of Toronto is testing a number of vehicles powered by alternative fuels, including this prototype electric van.

Photo by Jocelyne Richards, City of Toronto Archives.

fuels. Government and private fleet operators need incentives to join demonstration programs and to place large orders for alternate-fuel vehicles. Such demonstration programs will help provide the experience and data needed to advance commercially attractive alternate-fuel technologies. It is unlikely that the use of alternative fuels will have any significant impact on total energy consumption or emissions from vehicles over the next 10-15 years.

Recommendations: 39. That the City of Toronto support further research and development efforts in the area of alternative fuels.

MANAGING TRAFFIC INCLUDING ROAD PRICING AND IDLING

Good traffic flow management can reduce vehicle emissions by allowing vehicles to operate at their optimal fuel efficiency. The measures described below are common traffic management tools which promote energy conservation, and thereby reduce total vehicle emissions by increasing the efficiency of the transportation system. Since many of these measures may improve traffic-flow, there could be an increase in travel, offsetting potential energy reduction. Therefore, measures noted here must be enacted along with auto trip reduction measures described elsewhere in this report.

Traffic Signal Coordination

The Ministry of Transportation estimates that up to 20% of all emissions could be reduced through better coordination of traffic signals and improved signal timing. If traffic signals were timed to be better coordinated and responsive to the traffic flow, acceleration, deceleration and unnecessary stopping would be reduced, thereby reducing unnecessary idling and emissions.

Improved signal timing, coordination of traffic signals and the provision of traffic responsive signals are presently under study by the Metropolitan Corporation. A new $1.2 million pilot project called SCOOT (Split, Cycle, Offset and Optimization Technique) was approved by the Metropolitan Transportation Committee on June 14, 1990. The new system will feature sensors embedded in the pavement that will measure actual traffic conditions. An advanced computer program will then adjust the signal lights such that their timing coincides with the volume and direction of the traffic. Tests in England have shown SCOOT can reduce

The City of Toronto
is considering
introducing a
By-law to restrict
unnecessary idling
— a significant
source of air
pollution.

Canapress Photo (Lynn Ball)

waiting times at traffic signals by 12 to 27 percent, and cut actual travel times by as much as 6%. As such, emission levels are also reduced.

Signal Priority Treatments for Buses and Streetcars

The Department of Public Works and the Environment has for the last three years participated in the Main Line Transit Priority Study. A result of the study has been the selection of a section of Queen Street West from Bathurst Street to Dufferin Street as a test site for transit priority traffic signal operations. These operations allow public transit vehicles to have a longer green (or red) phase at intersections so that passengers may load and unload without the transit vehicle losing time at the intersections. The phasing of the lights can be controlled automatically or by the driver. This system is discussed in more detail in Appendix 7. The necessary hardware has been installed and field testing is being undertaken to evaluate the system. The final report on this study is expected to be ready by early summer 1991. If successful, a recommendation will be made to expand this transit priority system to other streetcar routes in the city.

Removal of Unnecessary Stop Signs

There are presently some 4,800 stop signs in the city of Toronto. Approximately 2,000 of the stop signs are at intersections where all approaches are controlled by a stop sign. Energy and emission savings can be realized by eliminating signs which are not necessary for safety or traffic control.

Each time a vehicle stops from an average speed of 50 km/h and accelerates back to 50 km/h, approximately 0.0367 extra litres of gasoline are used above that which would have been necessary to maintain a constant vehicle speed. This yields .091 extra kilograms of CO_2.

The Toronto Department of Public Works and the Environment is currently reviewing the placement of stop signs in the city, to ascertain which signs can be removed without adversely affecting the safety of either road users or pedestrians. An evaluation of the energy saving possibilities will be included in this study which scheduled for completion in early summer 1991.

Turning and Lane Use Restrictions

Vehicles attempting to make turns have the potential to block other traffic movements, especially when dedicated turn lanes are not provided. It is estimated that at a typical intersection in the city with significant left turn volume, energy consumption and corresponding vehicle emissions could be reduced by 1-2% if left turns were prohibited. The Department of Public Works and the Environment is continually reviewing the traffic flow throughout the city with a view to eliminating particularly disruptive turns.

Idling and Emissions

Idling of vehicles is costly both in terms of money and air quality. According to the Ontario Ministry of Transportation (1989a), an idling diesel engine uses about 2.5 litres per hour of fuel and an idling gasoline engine uses 3.5 litres per hour. It is estimated that pick-up and delivery trucks likely spend 20-40% of their time idling, approximately 2.5 hours every working day. Tour buses probably spend equal time with engines running while waiting for passengers; this results in significant fuel consumption and emissions. Exhibit 17 summarises the rates of fuel consumption and emissions for an idling engine.

The rate of CO_2 emissions for automobiles is in direct proportion to the amount of fuel which is burned. It is estimated that approximately 5,781 kg. of carbon dioxide would be discharged during 1,000 vehicle hours of idling for a car burning gasoline and 6,519 kg. of CO_2 for a diesel burning vehicle.

Although idling does not generate as much emissions as when the vehicle is moving (Matzoros, 1990), idling is mostly unnecessary for more than a few minutes. The Ministry of Transportation reports that "idling a diesel engine more than three to five minutes can contribute to engine damage and that after 60 minutes a stopped engine is warmer than one left idling". The reduction of idling, therefore, is a useful component in a package of measures to reduce vehicle emissions.

EXHIBIT 17

RATES OF FUEL CONSUMPTION AND EMISSIONS, AND TOTAL VEHICLE OPERATING COSTS FOR AN IDLING ENGINE

Item	**Amount per 1000 vehicle hours**
Fuel	2460 L of gasoline
Carbon monoxide	1100 kg
Hydrocarbons	72 kg
Nitrogen oxides	23 kg
Total vehicle operating costs (at $0.50/L)	$1230

Source: Federal Highway Administration 1980

Road Pricing

Road pricing refers to the concept that users of a congested road should pay a price for the delay they impose on others. In the absence of such pricing, as is the general case, peak-period auto use will go under-priced and over-produced, resulting in high levels of traffic congestion. As urban traffic congestion continues to increase, the case for selective, peak-period road pricing on major arterial streets becomes stronger and, with recent developments in electronics, the technology to implement road pricing is now available (Chartered Institute of Transport 1990).

Road pricing can be done through area licensing, in which payment is required to drive in selected areas, or through electronic road pricing. Electronic road pricing schemes include: automatic vehicle identification at selected locations; on-vehicle meter systems, and ramp metering for entering highways.

Road pricing has been undertaken in a number of jurisdictions, including, Singapore, Hong Kong, and Stockholm. Experience in these areas suggests that this technique can effectively reduce traffic by providing a disincentive to car use. In Singapore, the number of car journeys has been cut by 44% and the flow of traffic improved (The Economist 1990). The revenue which is generated through road pricing can be directly invested in upgrading the public transit system. In addition, the cost to the driver would induce a switch to public transit or off-peak-times leisure travel. While administrative and enforcement problems have been found to be manageable, and both electronic and simpler permit systems are feasible, there are particular social issues which need to be addressed. For instance, expensive roads will have a greater impact on drivers with less disposable incomes, and sophisticated systems which track people's movements may threaten privacy. At this time, road pricing should be studied further before being implemented.

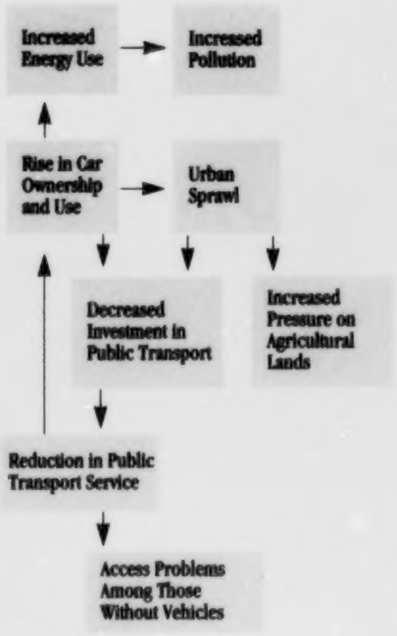
Recommendations:

40. That the City of Toronto bring forward a by-law to restrict unnecessary idling.
41. That the City of Toronto and the Municipality of Metro Toronto jointly fund a study of road pricing to determine the best model for Toronto, as a possible long term option.

6. PLANNING FOR FEWER CARS

EXHIBIT 18

TRANSPORT POLLUTION: LINKAGES AND FEEDBACKS BETWEEN CAR USE, PUBLIC TRANSIT, URBAN SPRAWL AND POLLUTION


Increased Energy Use
Increased Pollution
Rise in Car Ownership and Use
Urban Sprawl
Decreased Investment in Public Transport
Increased Pressure on Agricultural Lands
Reduction in Public Transport Service
Access Problems Among Those Without Vehicles

Source: OECD 1990

Coordination between transportation systems, land use (for housing and employment), and urban population density is imperative for resolving problems of vehicle emissions and traffic congestion in the long term. Population density is a determining factor in the allocation and frequency of public transit. In places where population density is low, people rely more heavily on the automobile because the distance they must cover to access public transit is large. Exhibit 18 illustrates the linkages between car use, public transit, urban sprawl and pollution. Frequent public transit service is unwarranted and not financially feasible in places with low population densities.

At a population density of 2000 p/km^2, frequent public transit is not a viable alternative to the automobile. At 4000 p/km^2, there can be adequate public transit although a subsidy is needed. At a population density of 6000 p/km^2, public transit pays for itself, although at 8000 p/km^2 the revenue generating capacity is even greater (Municipality of Metropolitan Toronto 1990a). These figures are averages, so certain areas where density is higher may compensate for a lower ridership in other areas. In addition, in certain corridors of higher density within lower density (for example, Yonge Street North) regularly scheduled routes do not require subsidization. Further, Kenworthy and Newman (1989) have found that the relationship between population density and gasoline use is more exponential than linear (see Exhibit 20); that is, at densities below 3000 p/km^2, gasoline use increases dramatically. This is because only at 4,000 p/km^2 does public transit become a viable transportation option.

Exhibit 19 provides a summary of average population densities in the GTA and other cities. As can be seen, the Metro population density at 3,500 persons per square kilometre is considerably higher than in the four regions and the Greater Toronto Area.

The city has development densities that can support an excellent transit system. Good transit, in conjunction with increased housing densities and adjacent employment opportunities in the city can reduce the number of cars commuting to the city and lessen travel time and costs for employees (Nielson, 1990).

EXHIBIT 19

A COMPARISON OF URBAN DENSITY AROUND THE WORLD

Metropolitan Areas*	Population	Urban Density (p.p.km2)
City of Toronto	612,000	6,000
Metro Toronto	2,200,000	3,500
4 Regions (urban area)	1,800,000	2,100
G.T.A. (urban area)	4,000,000	2,700
Chigaco	8,116,000	1,750
Frankfurt	2,500,000	5,400
Hong Kong	5,396,000	29,330
Los Angeles/Long Beach	12,000,000	2,000
London	6,800,000	5,63
Munich	2,315,899	5,690
Paris	8,500,000	4,830
San Francisco	2,731,400	1,550
Singapore	2,586,000	8,320
Sydney	3,358,500	1,760

*Metropolitan area refers to the urban area of each region.

Sources: City of Toronto 1991a
Institut D'Estudis Metropolitans 1988
Kenworthy & Newman 1989
Ontario Ministry of Transportation 1989

The Planning and Development Department has determined that every new Central Area dwelling unit will reduce inbound peak travel by 1.2 trips (City of Toronto 1990). Therefore, if 1,000 housing units were built downtown, total inbound trips could be reduced by around 1,200 trips in the morning peak period, since these workers would have other options to driving.

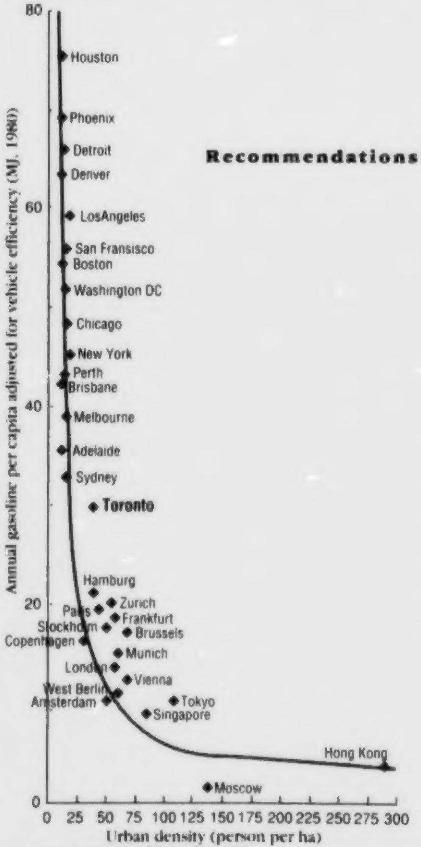
Local land use plans based on intensification can contribute to a more efficient use of transit services. There are several existing opportunities for increased housing in the city. Approximately 16,000 units can be accommodated through the Railway Lands and Ataratiri - two new large development areas. The Housing on Main Streets initiative is reviewing current City policies and legislation with a view to amending the by-law, where appropriate, to encourage the provision of housing over stores when main street properties are renovated or redeveloped. With these changes, up to 50,000 housing units could be built over the next 20 years.

The real challenge lies in avoiding the growth of auto use for commuting from the suburbs into the city. The recent study by IBI Group (1990) considered three land use scenarios for accommodating the projected growth of 60% in the GTA population by 2021. Under all three alternative urban structures, large increases in traffic will have to be absorbed on the roads. Estimates range from a 44% increase in peak hour auto kilometres to 86%. None of the proposed urban structures provide a solution if auto use goes unchecked.

Both the IBI study and a recent Metro study (Municipality of Metropolitan Toronto 1990a) suggest that under all scenarios some road construction will be needed. In the GTA, however, it is essential that options for increasing transit be fully developed and road development minimized. This is important for both environmental and social equity reasons. Increased investment in roads disadvantages the young, poor, elderly and others who cannot use a car, and takes away possible sources of funding from public transit which is potentially beneficial to everyone. As a result, transit services deteriorate and the resulting urban form favours car use. Therefore, a heavily auto-oriented GTA could produce a socially hostile environment for everyone living in the region (City of Toronto 1990).

EXHIBIT 20

URBAN DENSITY VERSUS GASOLINE USE PER CAPITA IN CITIES AROUND THE WORLD



Source: Newman, P. and Kenworthy, J. 1989

The Department of Public Works and the Environment has recently completed a report on auto minimization strategies in new non-residential developments (City Services Report #3, Clause 55, 1991). The report recommends that the City require that new non-residential developments prepare Transportation Demand Management Plans (TDM) to minimize automobile use in connection with their proposals. In addition, the report recommends that the necessary legislation and compliance control be enacted to properly enforce the process.

Recommendations: 42. That the City of Toronto increase the supply of Central Area housing, to reduce the need for inbound commuting. Such initiatives should include:

(a) the intensification of residential development along major city streets served by transit, as provided by the Housing on Main Streets Program;

(b) the development of new residential areas such as Ataratiri, the Massey lands and the Bathurst/Spadina neighbourhood;

(c) appropriate redevelopment and infilling in existing residential areas; and

(d) relating the production of office space to the building of new residential units in the central area.

43. That the City of Toronto encourage similar land-use intensification strategies at the Metro and regional levels, to discourage further urban sprawl and auto-dependency.

44. That the City of Toronto discourage road expansion projects which would increase automobile commuting into the city.

45. That the City of Toronto examine the feasibility of requiring that transportation demand management plans be developed in existing non-residential developments with over 75 parking spaces.

PARKING FOR AUTOMOBILES

Parking management refers to the regulation of the price and/or supply of parking facilities. By ensuring that an appropriate supply of parking facilities are provided at appropriate locations, the overall efficiency of the transportation system may be improved by limiting unnecessary trips, shortening the search time experienced by drivers locating a parking spot and limiting the intrusion of traffic on local streets.

A study is currently being conducted as part of the Cityplan '91 Official Plan Review, to measure the impact of the parking supply and pricing on auto commuting in the city. Preliminary results of the study indicate that Central Area auto commuters may be sensitive to changes in the parking supply, however, further study is necessary before precise strategies to limit supply can be recommended.

In the Central Area where transit is a viable alternative for the commuter, there are several ways in which controls on parking supply could act as an effective deterrent to daily commuting into the city.

Limiting Parking for New Office Developments

The City of Toronto currently regulates the amount of parking provided within new developments through its Comprehensive Zoning By-law. The Zoning By-law specifies the minimum number of spaces which must be provided, (and in the case of the Central Area also regulates the maximum number of spaces which may be provided) based on the land use under consideration. The standards applying to the Central Area resulted from a comprehensive study conducted during the 1970's. The minimum requirements are intended to reflect the "auto-captive" segment, that is, persons who have no other reasonable access method, and to require the property developer to bear the cost of providing parking for this minimum traffic created by their project.

Currently, the City of Toronto requires that new office and commercial developments provide parking spaces for residents and users. The City requires that new developments in the Central Area provide a minimum of one parking space per 300 square meters of office development and a maximum one space per 135 square metres. The cost of these to the developer is very high. The parking requirement for new developments was decreased in 1978 to discourage cars from entering the Central Area. Given the proposed changes to the public transportation system, it may be appropriate at this time to review these minimum requirements.

Workplace Parking

The TTC found in its 1989 survey that 54% of non-transit-riders and light riders surveyed said they drove to work because their employer provided parking for free or at a reduced cost. As well, the Canadian government

One way to slow growth in demand for more transportation capacity, and particularly additional road capacity, is to add more housing downtown, so people can live closer to their workplaces, and take transit, cycle, or walk to work. Locating more housing downtown not only makes sense environmentally, it also makes economic sense, because the services needed for new residents — sewers, schools, roads, etc., already exist, or can be easily added.

Photo by Vince Pietropaolo.

currently allows employers and employees to receive tax deductions for purchasing and using automobiles for work related purposes (which may include the drive to work). In addition, employers often use parking allowances as an employee benefit. At the same time, if an employer chooses to give transit passes to employees, they are forced to declare them as taxable incomes. Changes are needed in these areas to encourage other modes of travel. Rather than free parking, employers could provide employees with a bonus which could either be used for parking or transit.

The Provincial Commercial Concentration Tax currently provides an exemption for parking free of charge. This can act as an incentive for employers to provide free parking at the workplace. If employers were required to pay the tax, however, it might become a disincentive to the parking subsidy.

Parking On Major Arteries

Eliminating curb lane parking, especially along all major arterial and collector streets in the city and Metro, reduces total energy consumption by reducing stop-and-go traffic and eliminating unnecessary delays and idling. It also facilitates movement of buses and bicycles.

For example, the proposal for an expanded transit priority network (outlined in Chapter 3) requires that all on-street parking on affected streets be eliminated during rush hour. The transit priority therefore provides an alternative to the car on main roads. The Bay Street Clearway is an example of this. Between 7:00 a.m. and 7:00 p.m. each day, one lane in each direction is restricted to public transit, emergency vehicles and taxis. During these hours, parking and stopping are strictly forbidden in the curb lanes. Recent data collected by the TTC showed average travel time differences from Yorkville Avenue to Wellington Street (the clearway portion of Bay Street) before and after the Clearway to be in the range of +5 seconds to 3 minutes 4 seconds faster.

All Day On-Street Parking In Residential Areas

On all streets in the city, parking is allowed for only three hours during the daytime and only by permit overnight. However, in several areas of the City, the Annex for example, the daytime parking restrictions are not regularly enforced on residential streets. For commuters, this provides an opportunity to drive into the city and park relatively close to their workplace, often at no cost. In addition, many commuters drive to residential locations near subway stops in the city rather than to the public transit station closest to their home. Better enforcement of the parking restrictions for non-residents (non-permit holders) would discourage these trends.

High Occupancy Vehicle (HOV) Parking

The automobile will continue to represent the most viable transportation option for people living in some low density suburban areas. In addition, there are people who work shift hours, when public transit may not be accessible. In cases where driving is required, it is important to encourage an increase in vehicle occupancy, which has, in fact, declined over the past 15 years. A car with more passengers is more fuel efficient, and contributes less to congestion on a per capita basis. High occupancy vehicle ridership should be encouraged for the journey to the public transit system, and preferential parking should be provided for these drivers at the public transit stations.

Recommendations:

46. That the City of Toronto encourage employers to eliminate or reduce parking subsidies provided to employees.
47. That Toronto City Council show leadership in this area by replacing subsidized parking for Councillors and employees with incentives for taking transit, walking or cycling.
48. That the City of Toronto urge the Governments of Canada and Ontario to reduce or eliminate all corporate automobile related tax deductions for employees who use their car for non-work-related purposes.
49. That the City of Toronto urge the Government of Ontario to apply the Commercial Concentration Tax in cases where parking is provided free of charge, particularly in the Central Area.
50. That the City of Toronto request that the Metropolitan Toronto Police Force increase its enforcement of the three-hour daytime parking restrictions in residential areas for non-permit holders.
51. That the City of Toronto request TTC and GO Transit to provide preferred parking; that is, parking spaces closest to the station, to vehicles carrying two or more passengers, in at least 10% of the parking spaces in all their stations with parking facilities.

PARKING FOR BICYCLES

Providing secure parking, showers and change facilities at the workplace is essential for bike-to-work trips to reach their potential. Approximately 5% of cycling enthusiasts who do not bike to work cite the provision of bike parking as the most important means of encouraging them to cycle commute, according to the City Cycling Committee's 1989 survey. A further 2% cited showers and change facilities as their most important need. A new zoning by-law is needed which would require all new developments to provide parking and change facilities for commuters. Existing buildings should be encouraged to follow suit, perhaps through tax incentives or some other positive approach.

The City also has an important role in providing parking for bicycles, just as it provides thousands of parking spaces for cars on the street and in Toronto Parking Authority lots and garages. In addition to requiring or encouraging bike parking at large developments, the City should ensure that bike parking stands be provided whenever sidewalks are constructed or existing sidewalks reconstructed on streets with commercial, institutional and recreational uses. Bike parking should also be provided at all City-owned properties, including parks and recreation facilities, public buildings, surface parking lots and parking structures where feasible. Toronto Parking Authority lots have tremendous potential to provide very secure, sheltered bike parking for large numbers of bikes. Bike parking can be provided at a fraction of the cost of providing car spaces and up to 12 bikes can be parked in the space of one car.

The City Cycling Committee has installed approximately 175 post-and-ring bike stands per year for the past four years but increasing demand by cyclists and merchants suggests it is not nearly enough. The Committee received requests for approximately 650 bike stands in 1990 alone. The Cycling Committee proposes that the bike rack program be expanded to 1,000 bike racks per year for the next five years. This will allow bike racks to be installed on an area wide basis rather than the current piecemeal approach of responding only to requests from the public.

The need for secure
bicycle parking and
end-of-journey
change and shower
facilities will
increase as more
commuters discover
the benefits of
pedal power.

Photo by Joanne Mogridge.
City of Toronto Archives.

Recommendations: 52. That the City of Toronto adopt new zoning by-laws which would require all new major developments to provide secure bike parking and shower/change facilities for bike commuters.

53. That the City of Toronto encourage and offer incentives for existing developments to provide secure bike parking facilities to meet the demand.

54. That the City of Toronto expand the bike rack program from the current level of 175 post-and-ring stands per year to 1,000 per year for the next five years. This will enable the City to meet the growing demand from cyclists and merchants and to ensure that racks are installed in all new or reconstructed sidewalks and at all City-owned properties.

55. That the City of Toronto, through the Planning and Development Department, and the Toronto Parking Authority develop a program to provide bike parking facilities at appropriate locations.

DECOMMISSIONING THE GARDINER EXPRESSWAY

As the Royal Commission on the Future of Toronto's Waterfront pointed out in its report of August 1990, ". . .the Gardiner - Lakeshore Expressway is incompatible with the fundamental environmental and land use objectives in the Central Waterfront. The elevated section of the Gardiner Lakeshore Expressway should be taken down, in a phased program, over the next 20 years. As part of the process, plans should be made to improve public transit, roadway, pedestrian and bicycle transportation" (Royal Commission on the Future of Toronto's Waterfront 1990).

Dismantling the Gardiner Expressway would not only serve to strongly reinforce the numerous transit priority measures recommended in this report, but would do much to integrate the waterfront with parts of the city north of the Gardiner. Lakeshore Boulevard would remain but could be lined with trees. Land currently used for on-ramps and off-ramps would be freed for other purposes. This might represent the first example in the world of a city reversing a previous act of unsustainable development. It would send a clear and unmistakeable message that the people of Toronto and its environs are serious about reversing our growing problems of atmospheric pollution.

The elevated central portion of the Gardiner Expressway is the most visible of all barriers to the City's Waterfront. The Royal Commission on the Future of the Toronto Waterfront is studying the feasibility of taking down this eyesore, an initiative the City supports.

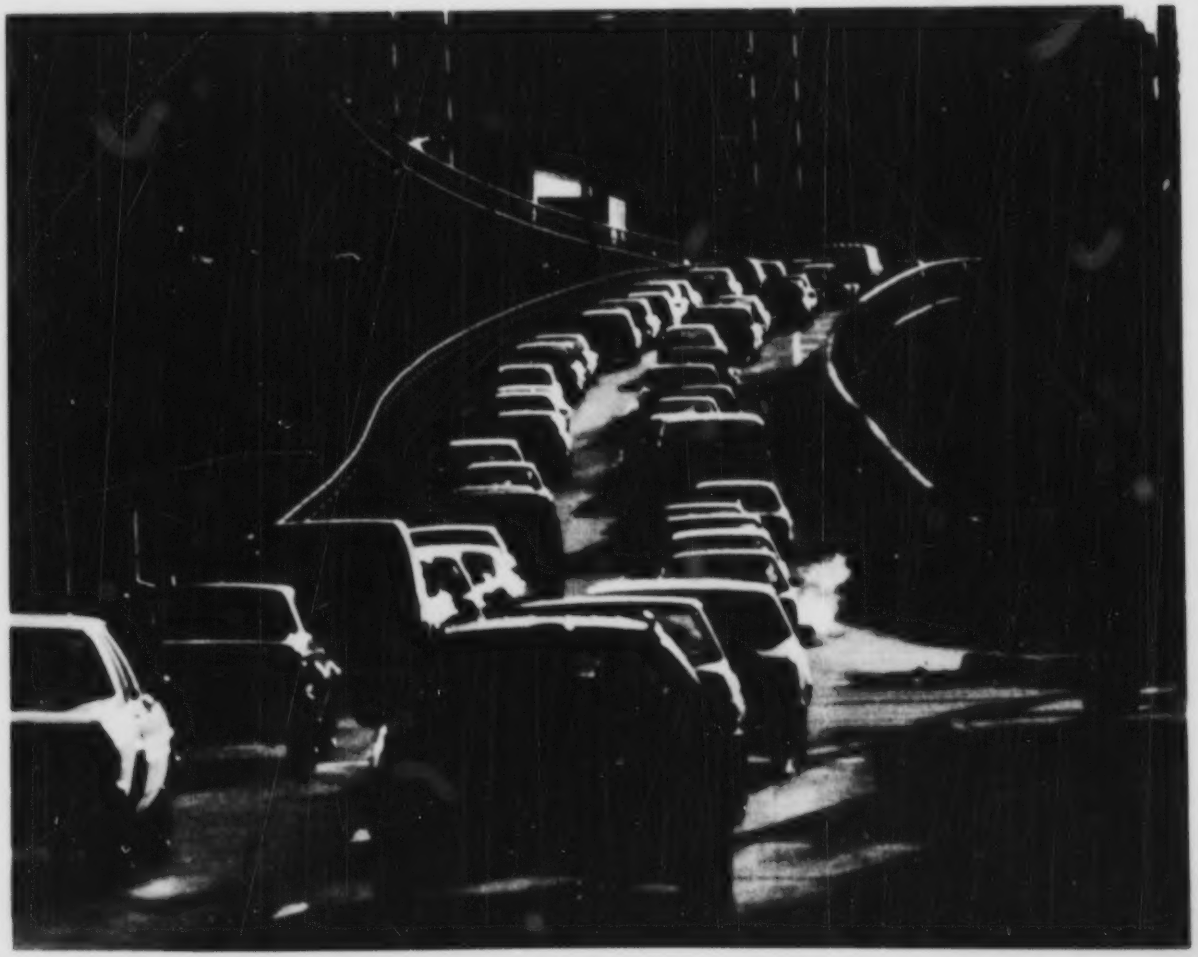


Photo by Canapress.

The complete set of proposals recommended in this report would substantially reduce the need to use private automobiles for commuting into and within the City of Toronto. As a result, the need for the Gardiner Expressway could be largely eliminated.

The ramifications of such an action, however, have yet to be studied. For example, there is a need to understand the extent to which the Gardiner Expressway is part of the Greater Toronto Area "ring road" network bounded by the Don Valley Expressway, Highway 401 and Highway 427. Also, it will be necessary to understand the dimensions of the additional passenger handling and railway line capacity necessary to accommodate the traffic diverted from the Gardiner Expressway.

In the interim, the feasibility of implementing HOV lanes during peak periods on the Gardiner Expressway should be explored. Such an option should be examined in the context of concurrent increases in the frequency of GO Transit service within the adjacent rail corridor.

Recommendations:

56. That the City of Toronto urge the Municipality of Metro Toronto and the Province of Ontario (Ministry of Transportation) to examine the economic and transportation impacts of decommissioning the Gardiner Expressway.
57. That the City of Toronto urge GO Transit and the Government of Ontario (Ministry of Transportation) to assess the train service - and related incremental rail plant infra-structure needs - necessary to accommodate the additional traffic as a result of the potential decommissioning of the Gardiner Expressway.
58. That the City of Toronto urge the Government of Ontario (Ministry of Transportation) to consider the immediate implementation of HOV lanes on the Gardiner Expressway during rush hour, as an interim measure.

7. BREAKING THE CAR HABIT

If automobile emissions are to be limited, active interventions directed at reducing vehicle kilometres travelled are essential. Despite new technology and increasing regulatory standards which have reduced the emission levels for individual automobiles, increasing car ownership, a growing population in the GTA, and decreased auto occupancy rates have largely offset any gains made in limiting pollution.

If present population and consumer trends continue, vehicle ownership and road traffic in Metro Toronto is expected to double over the next 35 years. In addition, in the next 20 years, the population of the four regions outside Metro will increase by four times that of Metro Toronto. These facts highlight the potential increases in vehicle trips and accordingly the potential increase in vehicle emissions which would result should no action be taken to reduce this trend.

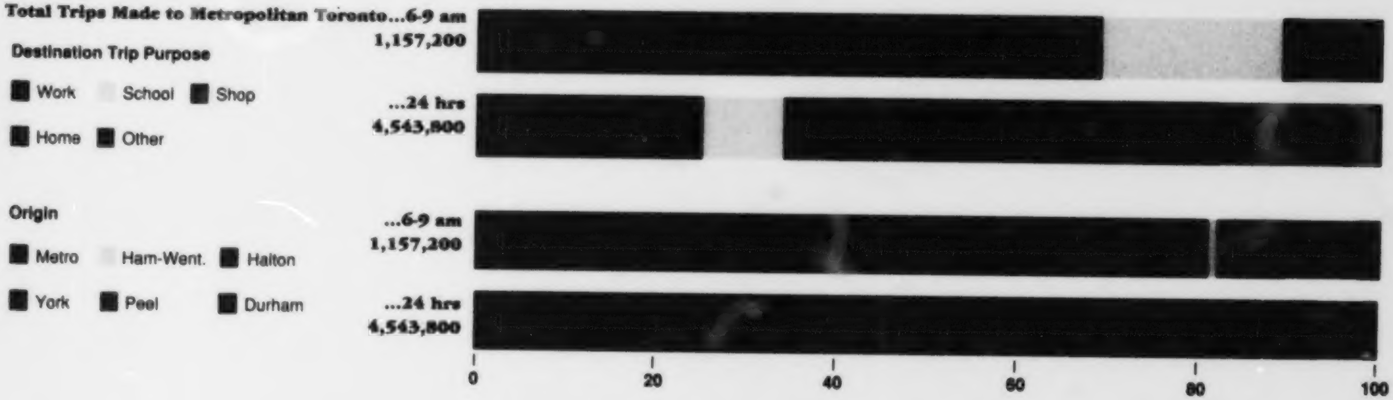
Automobile Trips

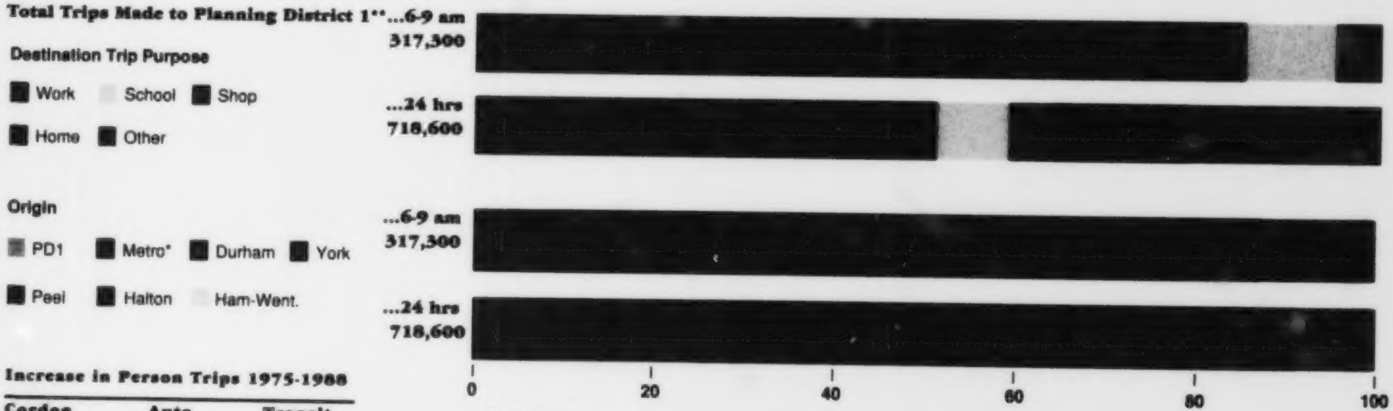
The number of vehicles currently entering Metro on a daily basis is 2.5 times what it was in 1975 (Municipality of Metropolitan Toronto, 1989). Exhibit 21, together with Exhibit 8, provide an outline of daily travel patterns into Metro and the central area of the city. From these and other data, several significant trends emerge.

- During the morning rush hour, 84% of commuters from outside Metro use their cars to come into the Metro area. While the proportion of people who travel by car in the morning has decreased by 7% since 1975, the absolute number of person trips during this period has increased by 143%.
- Over the past 25 years, automobile trips in the GTA increased at twice the rate of the population growth.
- The residence distribution of downtown workers shows that of the over 700,000 trips made into the Central Area everyday, less than 10% are made by travellers who live downtown.
- There has been a 20% increase in the number of automobiles, and a 12% increase in person trips into the Central Area since 1975.

EXHIBIT 21

ORIGIN AND DESTINATION OF DAILY PERSON TRIPS INTO METRO TORONTO AND THE CITY OF TORONTO





Increase in Person Trips 1975-1988

Cordon	Auto	Transit
Metro Toronto	143%	259%
Central Area	12%	33%
Downtown	13%	25%

*not including PD1

**Planning District 1 is roughly equivalent to the Central Area of the City.

Source: Ontario Ministry of Transportation 1989; Municipality of Metropolitan Toronto 1990

Vehicle Occupancy

Auto occupancy rates, from 1975 to 1988, have decreased by 2% (to 1.19 persons/vehicle) across the Metro cordon, by 7% (to 1.22 ppv) across the central area cordon, and by 5% (to 1.25 ppv) across the Downtown cordon during the morning rush hour. While this increment may appear small, it indicates a trend towards a less energy efficient use of the automobile and contributes to the close to 150% increase over 15 years in the number of vehicles which come into the Metro area every morning.

Automobile Ownership

Over the past 20 years, not only has automobile ownership increased, but so has the number of vehicles per household in Metro Toronto (Exhibit 22). In 1989 there were 1,172,557 vehicles registered in Metro Toronto, compared 748,521 in 1970.

A recently completed study of 32 cities around the world, including Toronto, provides an international comparison of automobile dependence, land use patterns and other factors affecting gasoline and car use. Exhibit 23 provides a summary of automobile dependence patterns in major western cities. As the table indicates, Toronto's dependence on the automobile in 1980 is higher than many urban areas studied, although lower compared to most U.S. cities under study.

These trends indicate that even though the number of people who commute on public transit has increased more rapidly than the number of people who use cars, the recent population growth in the GTA and a decrease in automobile occupancy means that the number of cars which come into the city (particulary the Central Area which remains the workplace focus for the region), continues to increase. In addition to the policy and infrastructure changes which have been proposed in this report, it is essential that people re-examine the role of the automobile in their lives.

There is, therefore, a need to address the educational issues related to our awareness of the impact of the car and the steps people must take to make the necessary changes in their use of the car. In addition, we must address the role that the city, as the centre of employment for the GTA, can play in reducing automobile trips.

EXHIBIT 22

HOUSEHOLD AUTOMOBILE OWNERSHIP IN THE GREATER TORONTO AREA

	1964	1979-80	1986
Durham	1.1	1.4	1.7
York	*	1.76	1.9
Metro Toronto	0.9	1.0	1.2
Peel	*	1.4	1.7
Halton	*	1.5	1.8
Hamilton-Wentworth	*	1.1	1.4
Greater Toronto Area	0.9	*	1.4

* Data not available

Total automobile ownership, GTA - 2,052,400
Metro - 993,168

Source: Ontario Ministry of Transportation 1986

EXHIBIT 23

PROVISION FOR THE AUTOMOBILE IN THE WORLD'S MAJOR CITIES (1980)

City	Gasoline Use (MJ per capita)	Car Ownership (per 1000 people)	Road Supply (m/person)	Parking Spaces (per 1000 CBD workers)	Total Vehicles per km of road
Houston	74,510	603	10.6	370	76
Los Angeles	58,474	542	4.5	524	158
New York	44,033	412	4.7	75	99
Melbourne	29,104	446	7.9	270	67
Toronto (b)	34,813	463	2.7	198	204
Stockholm	15,574	347	2.3	153	171
Paris	14,091	338	0.9	201	410
Munich	12,372	360	1.7	285	238
Amsterdam	9,171	308	2.1	208	161
Tokyo	8,488	156	1.9	66	140
Hong Kong	1,987	42	0.2	37	290
Moscow (a)	380	20	0.4	?	93

While the absolute number have most certainly increased since 1980, the Worldwatch Institute suggests that comparatively, the figures are very much the same for the late 1980's.

Note: a) Moscow commuter rail data are missing
b) Data refers to Metro Toronto

Source: Kenworthy and Newman 1989

WORKPLACE INCENTIVES TO REDUCE AUTOMOBILE USE

Ridesharing

Ridesharing was previously encouraged during the 1970s oil crisis. However, it was virtually abandoned when prices fell to pre-crisis levels. In light of present environmental concerns, ridesharing should again be encouraged as part of a medium-term solution to transportation problems, until better public transit and rail networks are in place.

Decreasing the number of cars on the road by increasing the number of people riding in the same car can immediately reduce energy consumption and total kilometres driven in Toronto, particularly from long-distance commuters:

- One person shifting from driving alone to a shared vehicle can save 609 litres of gasoline in one year;
- In one vanpool, where 12 people share the same vehicle, up to 29,000 litres can be saved per year, assuming an average trip of 80 km;
- Depending on the length of the trip and number of riders, drivers can save between $300 and $1,300 per year in reduced transportation costs;
- Region-wide energy consumption can be reduced by 3% - 5% (Ontario Ministry of Transportation and Ontario Ministry of Energy 1983).

The most common forms of ridesharing are car pooling in private cars, and van pooling in specially equipped 12-passenger vehicles. Other forms of ridesharing include paratransit, such as contract van services, shared taxis, and subscription bus.

Several strategies are already underway to increase public interest in ridesharing. The Ontario Ministry of Transportation has a program to encourage companies to develop ridesharing programs at their workplaces. The Ministry is also undertaking a feasibility study of a ridesharing program, which will include an assessment of designating certain highway lanes for high occupancy vehicles (ie. two or more passengers) only.

To further encourage ridesharing, HOV lanes could provide access to transit stations (GO and TTC) at gateways

City Council could promote more efficient use of private automobiles by introducing policies that encourage ride sharing, reserved lanes for vehicles with more than one passenger, and preferential parking for these high occupancy vehicles.

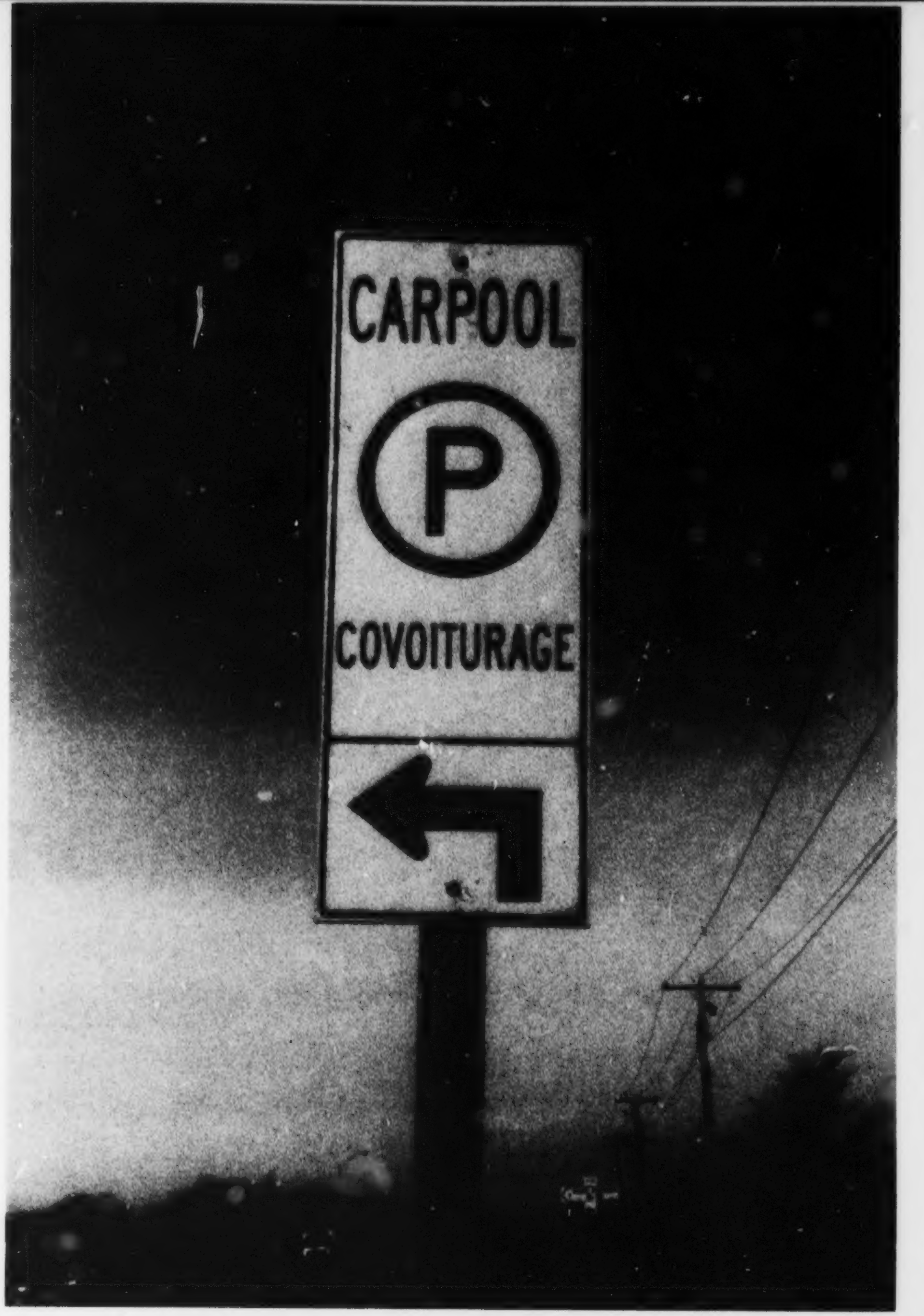


Photo by Vince Pietropaolo.

into Metro Toronto. As well, preferred parking (reserved spaces located closest to the station entrance) at TTC and GO stations could be provided to vehicles carrying two or more passengers. GO Transit recently implemented such a policy at Ajax, Oakville, Long Branch and Port Credit stations, allowing designated reserved parking for cars with two or more passengers.

It is important that ridesharing not be promoted where it will adversely affect transit use. The value of ridesharing programs is highest in areas without good access to public transit. Apart from expressways which are servicing commuter traffic from outlying regions, HOV (high occupancy vehicles) lanes should not be provided for private vehicles within the Metro region served by transit (Dunbar 1990).

The private and public sectors can play complementary roles in encouraging workplace ridesharing. The private sector can help to overcome social and financial barriers to ridesharing, and the public sector can provide preferential parking and priority lanes for high-occupancy vehicles. Municipalities can encourage ridesharing by establishing their own model workplace programs, and by promoting such programs among area employers (Dunbar 1990).

In California, the South Coast Air Quality Management District, encompassing Los Angeles and environs, requires all companies with 100 or more employees to prepare an annual transportation plan with detailed budget outlining ways the company will meet its required average vehicle ridership (AVR) goal. Fines for non-compliance run up to $25,000 per day. Similarly, the City of Sacramento, California, under its Transportation Systems Management Ordinances, requires any worksite of 25 employees or more to submit a transportation management plan to achieve a target at which 35% of their employees use alternative commuter modes to driving alone in a car. In both cases, transportation coordinators have been hired to manage the worksite program. The principles and methods which have been used provide a good model for the implementation of trip reduction programs in the workplace.

The City of Toronto can show similar leadership by developing its own model ridesharing program for municipal employees, and then by requiring local employers to actively promote ridesharing in their own workplaces. The City's ridesharing project could:

- survey municipal employees to determine current choice of transportation, interest in ridesharing, and collect information for matching ridesharing partners;
- develop automobile trip reduction plans with targets for the Corporation;
- appoint a coordinator to facilitate use of alternative transportation, to encourage travel partnerships among employees, and
- develop a package of ridesharing incentives, including preferential parking, free use of company vehicles, matching services, newsletters, etc.

The City could also encourage ridesharing in Toronto by requiring, as a condition for approval of building development plans, that all developers: 1) provide 30% of all parking spaces free for high occupancy vehicles in new office buildings; 2) disseminate information to residents and/or employees on ridesharing; and 3) develop promotional plans to encourage alternatives to car-use.

While ridesharing has the potential to reduce driving for long distance commuters, there are a number of other measures listed below which employers can take to enhance alternative modes of travel for all employees and reduce the number of automobile kilometres travelled.

Introducing Flexible Work Hours

Alternative work schedules can spread peak travel demand over a longer time frame, and therefore make street and transit operations less congested. The two most common alternative work schedules are: 1) staggered work hours, in which groups of employees leave at different hours; and 2) flexible work times, in which employees set their own times between certain hours. Studies of such variable work times have shown increases in transit use and ridesharing, with no rise in automobile use (Ontario Ministry of Transportation and Ontario Ministry of Energy 1983).

Another alternative work schedule option is the compressed work week, which is a regular work week compressed into four nine-or-ten-hour days. Compressed work weeks can reduce commuting by 20%. Studies in Toronto, Ottawa and several American cities have shown these measures reduce traffic congestion and travel time, and result in reduction of energy use and emissions (Ministry of Transportation and Ontario Ministry of Energy 1983).

Considering a Work at Home Policy

Where site offices and work demands permit, the option of locating staff close to home could be explored. Another option is a work-at-home policy. Factors to support a work-at-home policy include: the widespread availability and use of personal computers; the low cost of modems, allowing direct long-distance linkages; the advent of facsimile (fax) machines. There are also potential savings for employers by reducing office space and other overhead costs.

The Corporation of the City of Toronto could show leadership in this area by 1) investigating the potential of telecommuting among its own employees, 2) investigating a cost-sharing scheme of providing terminals and modems to its employees so that they can work at home part of the time, and 3) investigating what computer hardware and software may be needed to link up to people working at home.

However, any consideration of a work-at-home policy should ensure that certain groups, such as women and people with disabilities, are not disadvantaged by creating "home work ghettos". Having people work at home should not be a way for employers to resist the principles of equal opportunity, or to avoid making workplaces physically accessible for people with disabilities.

Subsidizing Public Transit Use

The TTC is the most viable alternative to the car for employees living within Metro Toronto. Instead of offering free parking to employees, as many employers now do, employers could provide free or subsidized Metro passes. Where necessary, revenues for this subsidy could be generated by charging for the existing parking spaces now provided free to employees.

Currently in Canada, employers can obtain tax deductions when they purchase or lease automobiles for their employees, and for expenses related to such use. However, if an employer provides a public transit subsidy to employees, the employee must claim it as taxable income. To redress this inequity, a tax deduction for public transit for both employers and employees could be adopted.

Facilitating Cycling

In addition to subsidizing transit passes for employees, employers could implement a number of measures to encourage bicycling. The City Cycling Committee has identified steps which could be taken immediately. They include: providing more parking for bicycles at work sites, as well as showers and change rooms for cyclists; subsidizing safety equipment and maintenance costs; facilitating networking among employee cyclists, including special seminars; creating a fleet of workplace bicycles for short-term business trips.

The City, as a large employer, can also provide a positive example for the private sector by encouraging civic employees to bike to work, and to use bicycles more often for work-related trips. Initiatives such as providing more and better bike parking, showers, and clothing lockers at all City government offices would make it easier to ride and dress for the job. Paying employees the same mileage for using their bicycles as for using their cars for work-related trips would reward an environmentally friendly form of transportation. Providing a fleet of City bicycles would allow those employees who live too far from work to commute by bike an opportunity to use a bicycle for work-related trips. Courses that teach bike commuters how to anticipate and prevent accidents, offered through the Employee Opportunities Program, could ease one of the major barriers to cycling - fear of traffic.

Reducing Emissions for Company Vehicles

A number of companies in the City and Metro own and operate their own vehicles. Employers have an opportunity to contribute to emission reductions by:

- adding more fuel-efficient vehicles,
- reducing idling,
- restricting vehicle use during rush hours,
- using gasoline alternatives such as electric cars, natural gas, or propane.

The City should take an active role in encouraging such measures.

Planning and Facilitating Trip Reductions by Car

Employers could establish voluntary goals for their workers to reduce car use in conjunction with reduced free parking, and subsidized transit passes, by providing a mechanism to encourage behaviour change.

An Employee Transportation Coordinator at each workplace could match potential transportation partners who live in the same neighbourhood and work in the same area. Each employee would receive a list of fellow employees with whom to carpool, vanpool, cycle, walk and take public transit, thereby providing options for getting to work each day. Grants and incentives could be made available by the provincial and federal governments to hire these coordinators.

Recommendations:

59. That the City of Toronto encourage all Toronto employers with over 100 employees in the city to develop trip reduction plans, including details on how the use of alternatives to automobiles will be supported and facilitated by the employer.
60. That the City of Toronto develop such a plan for its own employees, to be used as a model for other employers.
61. That the City of Toronto approve, in principle, the hiring of an Employee Transportation Coordinator to develop the model plan, and to work with employers to encourage workplace changes.
62. That the City of Toronto urge the Federal government to 1) make corporate benefits for non-work-related automobile use a source of taxable income, and 2) allow tax deductions for public transit related benefits.
63. That the City of Toronto promote the use of bikes among City employees by:
    i) providing more and better bike parking and clothing lockers for City employees who cycle to work;
    ii) paying City employees the same mileage for using bicycles as for using cars for work-related trips;
    iii) providing and maintaining a fleet of bicycles for use by City employees for work-related trips; and
    iv) offering cycling skills courses for City employees through the Employee Learning Opportunities Program.
64. That the City of Toronto encourage other employers, including Metro government, to provide the same facilities as mentioned above.
65. That the City of Toronto request the Federal and Provincial governments to provide tax deductions for

employer purchased ridesharing vehicles and bicycles as well as incentives to hire employee transportation coordinators.

66. That the City of Toronto, through the Healthy City Office, work with the Ministries of Transportation and Energy to develop a promotional campaign directed at city of Toronto employers, to encourage the establishment of employee transportation centres which match partners for ridesharing, public transit, cycling and walking.
67. That the City of Toronto request that the Ontario Ministry of Transportation expand its current ridesharing matching software (SARRMS) to include matching partners for walking, cycling and taking public transit.
68. That the City of Toronto request the Ontario Ministry of Transportation to initiate an area-wide ridesharing program along specified highways for the Greater Toronto Area, including High Occupancy Vehicle (HOV) lanes for buses and cars with two or more people.

EDUCATING THE PUBLIC

A public education campaign to reduce automobile use should be implemented in step with the other measures proposed in this report. Reduction in automobile use and the related pollution, needs to be seen as the responsibility of everyone who lives and works in downtown Toronto, requiring concerted and coordinated actions by all three levels of government, business and labour leaders and most important, the public.

Reducing the public's dependence on the automobile hinges on our ability to convince individuals that alternatives to driving - public transit, cycling and walking are feasible and beneficial to Toronto and its citizens. This call for individual action must be supported by structural changes such as improvement in transit and workplace incentives that make adoption of conservation measures easier for individuals (Dunbar 1990a).

Inundating people with information on the negative effects of driving may not achieve the objectives. A societal perception that unnecessary car driving is polluting city air, clogging city streets, and reducing the quality of life for all who live and work in Toronto will not necessarily mean individual drivers will curb their driving. Our society will remain geared toward automobile use as long as employees get free parking at their workplace; car drivers get tax breaks; and gasoline stays relatively inexpensive. Drivers need viable alternatives to using their cars: efficient, accessible public transit; friendly streets; streets that are safe for cyclists, and a road and parking system that supports ride-sharing. If these policies are in place, a public education campaign can build on them to create significant behavioral change among car users.

A public education campaign should encourage drivers to try alternative modes of transportation to commute. Group participation is often a key in behavioral change. Activities which encourage group involvement, like ridesharing, have been found to be successful in changing transportation patterns. The workplace can provide a focal point for involving employees in corporate programs which encourage alternate commuting modes and ridesharing, and for providing the financial and organizational supports necessary to allow employees to decrease their use of the car for work-related purposes. The family is also an ideal context for role modelling and for exerting influence upon individuals. A public education campaign could encourage families to eliminate additional cars from the household, to combine trips to reduce usage, and to use alternative forms of transportation. As well, families and schools can work together in designing alternative transportation programs, along with religious organizations, auto clubs and community and social organizations (Dunbar 1990 and 1990a).

Communities should be informed of ways they can play a role in improving their transportation systems, through problem-solving groups, involvement in bicycle right-of-way projects, or through political or corporate lobbying.

Lessons From Other Campaigns

A review of several public education campaigns related to vehicle use and emission reduction in the U.S. and Canada is summarized in Appendix 12. The following highlights some of the findings of these campaigns. The most frequently cited objectives of the campaigns were:

- vanpooling or ridesharing promotion as part of legislated trip reduction programmes;

- promotion of cycling;
- promotion of public transit;
- emphasis on financial savings for drivers through energy conservation or reductions in travel time or aggravation;
- promotion of environmental benefits.

While little evaluation of the effectiveness of these campaigns exists, some studies have found that attempts to modify driver behaviour are unsuccessful, unless other supports to manage traffic and emissions are also provided. In Switzerland, an attempt at behaviour modification failed when it only tried to convince people to change their habits.

Promoting alternatives to car driving can result in short-term changes, but long-term behavioral change requires significant policy supports. For instance, ridesharing programs require commitment and investment on the part of employers. Incentives, such as free parking for ridesharers, and resources for coordination and management, are essential also.

Government sponsored mass media campaigns, while exerting some positive influence on consumer's attitudes toward energy conservation, have limited effect on conservation actions (Joerges and Muller, 1983).

Public acceptance of traffic regulations and restrictions is enhanced when the goals, means, and instruments are clearly defined, and all affected parties are consulted prior to implementation. In Bologna, Italy, a plan to close the central city to non-essential traffic was developed following twelve months' of public consultation with haulage workers, bus and taxi drivers, downtown business owners, residents, and politicians. A year later when the central city was closed to general traffic and a pedestrian zone was created, the public called for further traffic restrictions (Sassi, 1990).

Leaders in the community can play a pivotal role in building support for measures to limit vehicle access. In Munich, Germany, a respected member of the retail business community was the catalyst in the development of a pedestrian precinct, helping to overcome shopowner resistance in the process (Meighorner et al., 1984).

A review of six model energy conservation programs in Europe which resulted in above-average energy savings, revealed a number of common features:

- considerable input from environmental, consumer and community groups;
- support from a national government policy framework;
- centrally-provided conservation information;
- active involvement by local utilities;
- measures offered repeatedly, through different channels and in different ways;
- programs tailored to different consumer groups, especially low-income consumers and tenants.

This study (Joerges and Muller, 1983) concluded that local energy-conservation programs can create high levels of participation among utility users, including marginal consumers, a group that is frequently missed by government sponsored mass media campaigns.

Elements of Public Education Strategy

We can learn from other campaigns that have been successful in changing behaviour and lifestyles: Participaction, (fitness), Breakfree (smoking), Steer Clear, RIDE, (drinking and driving). The communication strategies developed for these campaigns have relevance when attempting to change attitudes and behaviour concerning car use. Common elements of these communication strategies include:

- facts about the consequences of a behaviour/lifestyle, and its negative impact on the health of individuals and the community;
- information about what individuals can do, and how individual action can make a difference;
- a range of options, allowing individuals to change their behaviour, according to what is possible for them;
- incentives which reward responsible behaviour (eg. fuel pricing policies, workplace incentives);
- the message that wasteful behaviour is socially unacceptable;
- leaders and role models who demonstrate what is possible;
- messages targeted to specific population groups, including low-income consumers and specific

The City of Toronto Healthy City Office is taking a leading role in educating the public of the environmental benefits of switching from cars to public transit.

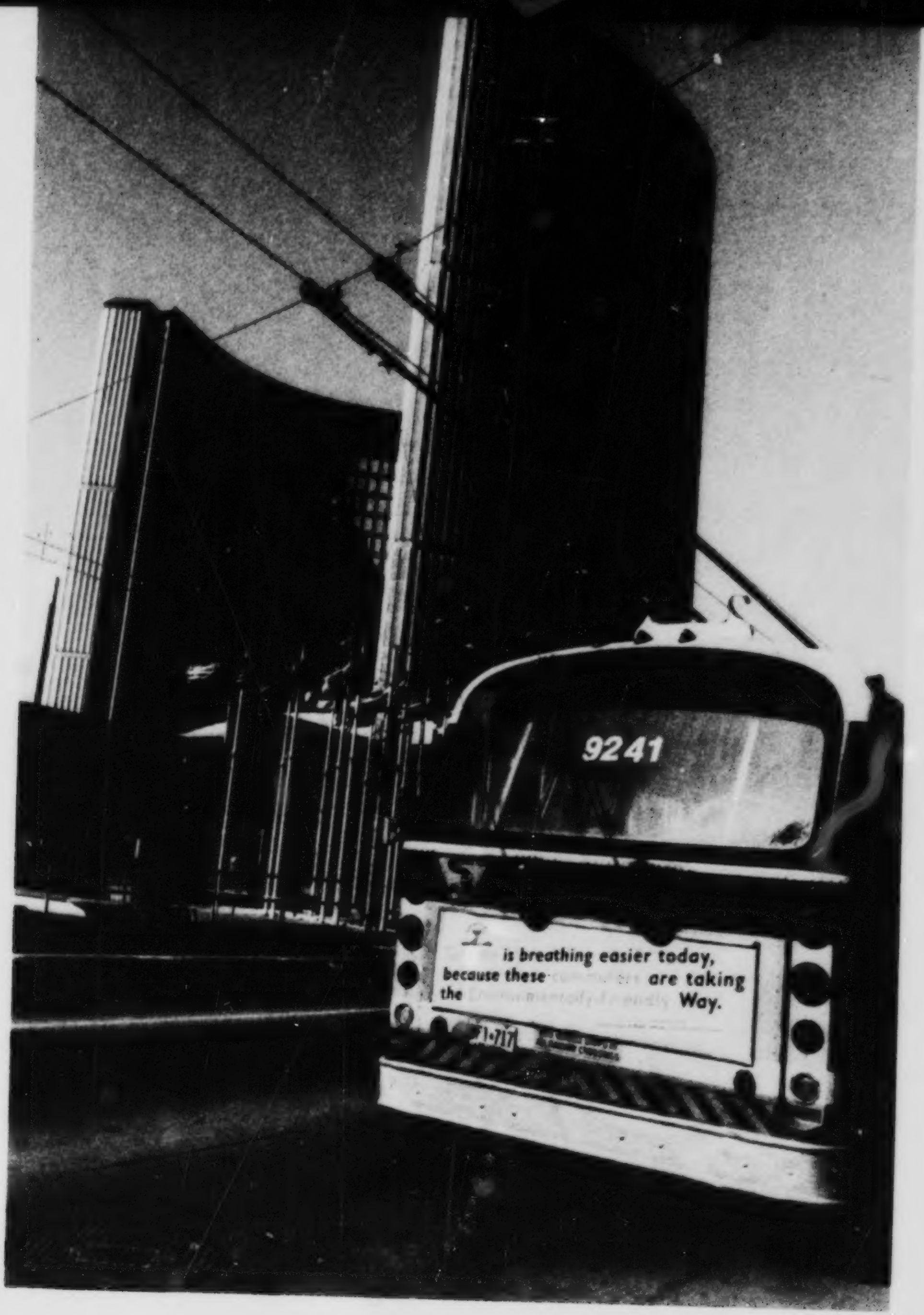

9241
is breathing easier today,
because these are taking
the Way.

Photo by Joanne Mogridge,
City of Toronto Archives.

ethno-cultural groups;

- group participation (employee and student groups, community groups, families) in establishing realistic goals;
- ongoing feedback and encouragement, including public assessment of results;
- activities that are focused at the community level through local citizens' organizations, neighbourhood groups, and personal contacts, and ongoing evaluation at that level.
- a series of messages that build upon each other over time;
- creating coalitions among a diversity of public and private sector organizations to support a common objective;
- messages that foster public awareness and support for legislative changes aimed at mandating desired behaviour changes; and
- consistent messages that are delivered by a variety of public and community agencies.

As part of its effort to change attitudes and behaviour associated with car use, the City should join forces with organizations, such as the Toronto Transit Commission, GO Transit, the Ministries of Transportation, Energy and the Environment, school boards, community groups, etc. to coordinate messages, and increase the impact of related campaigns.

The City's Role

The City can play a critical role in ensuring that messages delivered through the mass media are translated into action at the local level. The municipality can provide coordination and support within its jurisdiction; ensuring citizen involvement and input; and foster change by employers within its boundaries. Toronto has already taken on such a role in restricting smoking in workplaces and recycling of CFCs.

(a) Coordination and Support

A public education subcommittee of the Technical Workgroup has been formed with representation from a variety of organizations: The Toronto Board of Education, the TTC, the Ministry of Transportation, the

Department of Public Works and the Environment, the Information and Communication Services Division of City Clerk's Department, the Toronto City Cycling Committee, four citizen groups, a ratepayer, in addition to staff from the Healthy City Office. This group is looking at ways the City can tie into several ongoing public education initiatives. For example, both the Ministries of Energy and Transportation have province-wide campaigns focusing on energy conservation; the environment will play an important role in the TTC's 1991 marketing plans; the Lung Association is developing a curriculum for schools on air quality; the Toronto School Board is reviewing its policies on employee transportation, and students are initiating bike to school programmes. The Toronto City Cycling Committee is organizing its second Bike-to-Work Week. The City can support and supplement these activities, and fill in gaps where necessary.

(b) Public Involvement

The City must also keep citizens well-informed and involved in its plans to minimize car use and emissions through legislative and administrative initiatives. Torontonians must be made aware of the reasons behind new regulations and laws. The Bay Street Clearway is a case in point. The Healthy City Office and the Department of Public Works and the Environment jointly sponsored an advertising campaign to explain the reasoning behind the introduction of dedicated lanes for buses and taxis on Bay Street. External bus posters and interior ads with take-away-messages linked the clearway with improvements in the environment, and encouraged transit use and responsible driving. Public awareness and involvement will continue to be important, as clearways are extended to other city streets, and related legislation such as the anti-idling by-law is enacted.

(c) Leadership

The City should act as a role model for other employers to facilitate alternatives to automobile use. A Transportation Alternatives plan should be developed for City employees and Councillors which could:

- promote the use of public transit, including subsidized transit passes for City employees, and members of Council;

- make cycling to work safer, easier, and more convenient, by including provision of City-owned bicycles for work-related trips and/or reimbursement for work-related trips taken by bicycle;
- minimize access to free parking at all City-owned sites;
- seek alternatives to using City-owned or private cars for work-related trips, and ask departments to review and report on ways to reduce vehicle use;
- provide partners for employees who want to rideshare, do not want to take transit alone (especially at night), or want someone with whom to cycle walk to and from work;
- encourage flexible work hours and work-at-home policies for City staff where appropriate;
- continue to improve the energy-efficiency of City-owned vehicles;
- investigate opportunities for City inspection staff to share metre-reading inspection trips done by vehicle with other agencies, such as, Toronto Hydro, Consumers' Gas, etc.;
- City representatives be requested to use non-polluting delivery methods, e.g. bicycle couriers;
- redesign inspection routes so that Building, Health and Fire inspectors can use public transit, bike or walk;
- establish civic awards to recognize individuals, groups, companies, etc. who make significant contributions to Healthy City objectives;
- reinforce messages through promotional material produced jointly by the Healthy City Office, City Cycling Committee, Department of Public Works and the Environment and the Department of Purchasing and Supply.

These strategies are aimed at City staff. In addition to employees, the City should develop a public education campaign as outlined below.

Proposed Public Education Strategies

(a) Target Audience

The primary audience will be people who live in Metro Toronto and who drive in the City. Secondary target audiences will be employers, building owners and developers in the City. The third audience will be employees who drive into the City from beyond Metro Toronto.

(b) Communication Vehicles

- Workplace Education

  The City could prepare information for employers and building owners in the City of Toronto that would assist them in developing transportation alternative program/policies for their employees and tenants. This information would be developed in conjunction with TTC, GO Transit, the Ministries of Energy, Transportation and Environment, and the Toronto City Cycling Committee. Materials could also be prepared for employees explaining how their behaviour will affect the community.

- Targeted Resources

  Materials can be prepared specifically for audiences needing support or reinforcement, to use alternatives. As well, as part of its communications strategy, all meeting announcements and notices of City Services and locations should include information on the nearest transit stop, bicycle parking and walking routes.

- Participatory Events

  During Earth Week, Environment Week and Bike to Work Week, special events should promote transportation alternatives. Other special events, such as voluntary car free days could be organized.

- Speakers Program

  Appropriate City officials would be available to speak to community groups about alternatives to driving.

- School Educational Resources

  These would be prepared in conjunction with the school boards.

- Media Relations/Public Relations, Public Service Announcements

  Interviews and announcements would be made on cable television and radio stations.

- Community Action Coalitions

  The City would work closely with local environmental and health groups to promote messages and plan joint events.

- Awards

  Individuals and community based organizations could be recognized for initiatives to reduce car use.

- Community Report Card

  A regular update would be prepared on how well the City is achieving its vehicle use and emission targets.

- Advertising

  The City would produce messages for bus shelters, newspapers, etc. to promote special events and alternatives. Some advertising could be done in partnership with related organizations, corporations and municipalities in Metro.

- Display

  A travelling exhibit and backdrop for speaker presentations would be developed.

Recommendations:

69. That the City of Toronto, through the Healthy City Office and Information and Communication Services Division of the Department of the City Clerk, prepare a communication strategy and budget to encourage transportation alternatives to car use in the City of Toronto, in consultation with the Public Education Subcommittee of the Technical Workgroup.
70. That the Healthy City Office, through the Committee of Heads, bring forward the transportation alternatives plan for employees as outlined in this report.
71. That the City of Toronto request the Ministries of Transportation, Energy and Environment, as well as GO, TTC and the Parking Authority to cost share a study of drivers in the city to determine the best approaches for public education.
72. That the City of Toronto endorse a voluntary City Hall Car Free Week and establish a committee to implement a three-year program leading to a full city-wide car free week in 1993.

8. IMPLICATIONS AND FUTURE DIRECTIONS

Meeting the challenge of reducing traffic and emissions calls for bold and sweeping changes in the way we live and manage our urban environment. What kind of city do we want to live in and how do we want to live there are the basic questions we must answer. Motor vehicles, while bringing the benefits of increased mobility and broad access to goods and services, are also adversely affecting our health, the air we breathe and the world's climate. This report has reviewed the situation in and around Toronto and proposes specific ways to address the problem of growing pollution and congestion. What have we found?

Improvements in vehicle emissions are possible and feasible. The technology exists to improve fuel efficiency through vehicle design, fuel injection, high load operation, light weight materials and improved transmissions (Bleviss and Walzer 1990). Alternative fuels may also be options, with increased research and development, but only in the long term.

Nonetheless, technology alone is not the answer. Over the years we have seen significant gains in fuel efficiency and emission standards offset by increased driving and a shift to less efficient light trucks for personal transportation.

The answer lies in increasing efficiency of the transportation system as a whole. First, reductions in both traffic levels and emissions can be achieved by limiting dependence on individual cars and trucks and using buses, trolleys, trains, car and van pools, cycling and walking. In Toronto, where there is already an excellent public transit infrastructure, this is feasible even in the short-term. Specific improvements are necessary to enhance the attractiveness and effectiveness of the system. In this report, we outline measures to increase the speed and frequency of surface transit vehicles and expand and better coordinate the rail systems. We also looked at how the streets and public areas can be made more appealing and useable by cyclists and walkers. Given that the majority of daily auto trips to the downtown are made by Metro residents, the first step is to provide these drivers with viable alternatives.

The issue of increasing vehicle use due to longer commuting distances needs to be addressed in the short-term by improving rail service to the city, and fostering ridesharing to transit stations. In the long-term, land use policies and development that intensify housing in the city and provide a better mix of jobs, residences and services in suburban areas will help prevent further urban sprawl and related driving.

In the end, of course, we must each look to our own behaviour and lifestyle choices. While structural changes are essential to support the transition to less motor vehicle use, it is ultimately the day to day choices people make that will ensure success. The report describes ways that individuals, through their communities and workplaces, can make changes. We also outline a public education campaign that the city should undertake in conjunction with other agencies and organizations.

We have not explicitly addressed the question of cost in relation to each of the proposals, although we do suggest ways of financing transit improvements. The committee feels that if governments and the public recognize the necessity to act on this issue, monies will be found. There are already models of how environmental improvements can be financed through carbon taxes, manufacturers' levies, development assessments, "gas guzzler" taxes and so on. These would need to be examined by each level of government as it implements the appropriate measures.

The critical question is what trade-offs are we prepared to make? Reducing investments in roads and hidden subsidies to motor vehicles would be a good place to begin. Also, with less driving, there will be fewer accidents, hospitalizations, crop damage, illness, pollution and adverse climate change. These outcomes will result in real savings to lives and budgets. In addition, we know from recent surveys that people are prepared to pay for environmental benefits. We have seen that consumers will purchase goods and services that are less polluting, therefore, much change can come through the marketplace. As with other health and environmental problems, we cannot afford not to act.

Where Do We Go From Here?

This report reflects a consensus among a number of government departments, committees, transit organizations, citizens, environmental groups and business associations (Appendix 1), generally on what the problems are with respect to vehicles in the city and what needs to be done. Many significant steps are already underway at the federal, provincial, metro and city levels, but there is as yet no coordinated response to this issue. For instance, policies and regulations are still in place that encourage automobile use. City Council has indicated a strong commitment to reducing pollution and calming traffic. This report is intended to assist Council in achieving its goals of building a healthier city by reducing vehicle emissions and volume.

In order to ensure continued action, the Technical Workgroup proposes the following steps:

(i) Public Consultation

While there has been broad representation on the committee, there is need for wide discussion of the proposals and constructive input from the community, business, other levels of government. This will help refine specific measures proposed in the report. The Healthy City Office and the Technical Workgroup will work with City Council, City Services Committee and the Board of Health to ensure full discussion.

(ii) Follow-Up

There is a need for an ongoing mechanism to monitor the achievement of the recommendations in the report and assist City Council with advocacy to other levels of government. This can be best achieved by the Healthy City Office and the Technical Workgroup on Traffic Calming and Vehicle Emission Reduction which has government, community and business representation.

(iii) Coordination

In order for many of the recommendations in the report to work, it is very important that there be coordination among Metro and City policies and initiatives on traffic and transportation matters in the downtown core. There is already a joint Metro/City committee on downtown traffic issues, which should be the forum for ensuring continued coordination on the recommendations in this report.

(iv) Ongoing Public Education and Input

An important partner in the strategy proposed in this report is the public. A coordinated public education campaign is needed to ensure organizational and behavioral changes necessary to achieve the goals of traffic and emission reduction. As well, there needs to be a mechanism to allow and encourage ongoing input as plans develop. The Healthy City Office and Technical Workgroup are working with various groups and the City Clerk's Department to develop a public education campaign. Part of that campaign will be opportunities for additional community input.

Recommendations:

73. That the Healthy City Office, in conjunction with the Technical Workgroup on Traffic Calming and Vehicle Emission Reduction, undertake a series of consultations with a range of groups, organizations and businesses in the community on this report and report back to City Council in 6 months.
74. That the City of Toronto direct the appropriate City departments to report on how they can implement the recommendations and achieve the targets outlined in this report.

REFERENCES

Bailey, G.K. et al. 1990. Understanding urban travel growth in the Greater Toronto Area: volume 1. Downsview, Ontario: Ontario Ministry of Transportation.

Bates, D.V. and Sizto, R. 1989. The Ontario air pollution study: identification of the causative agent. *Environmental Perspectives 79.*

Bleviss, D. and Walzer, P. 1990. Energy for motor vehicles. *Scientific American 263 (3), 103-109.*

Burak Jacobson 1990. *TTC 1989 public attitude study: attitudinal and ridership analysis.* Toronto: Toronto Transit Commission.

CART, 1989. *Traffic Calming.* Brisbane, Australia.

Chappelaz, J., J.M. Barnola, D. Raynaud, Y.S. Korotkevich and C. Lorius 1990. Ice core record of atmospheric methane over the past 160,000 years. *Nature* 345, 127-131.

Chartered Institute of Transport 1990. *Paying for progress: a report on congestion and road use charges.* London.

City of Toronto 1991. *The changing atmosphere: strategies for reducing CO_2 emissions.* Special Advisory Committee on the Environment report number 2.

City of Toronto 1990. *Cityplan '91 report 13: The City in the region.* Toronto: Planning and Development Department.

City of Toronto 1988. *Toronto: state of the environment.* Toronto: Environmental Protection Office, Department of Public Health.

City of Toronto 1988a. Report to the Board of Health on August 31, 1988. Origin City Council, July 11, 1988 (c34hlth88098:357).

Crause, F., W. Bache and J. Koomey 1989. *Energy policy in the greenhouse.* El Cerrita Ca.

Dunbar, J. 1990. *Behavioral changes related to the use of the automobile*. Unpublished paper. Toronto: Transport 2000.

Dunbar, J. 1990a. *Social psychological basis for public education campaign to reduce automobile use*. Unpublished paper. Toronto: Transport 2000.

Economist 1990. Road pricing: it worked better in 1770. *The Economist*, November 10, 1990.

Ecoplan International. *Cars, Transport and Amenity in Urban Areas. A reader*. Paris, 1990.

Editions Amarcande 1990 (ed). *Better and safer streets through traffic calming*. France.

Environment Canada 1991. Written communication from the Technology Development Branch.

Environment Canada 1991a. Written Communication from the Transportation Systems Branch.

Special Advisory Committee on the Environment 1991. Written Communication.

Federal/Provincial Long Range Transport of Air Pollutants Steering Committee, 1990. Management Plan for Nitrogen Oxides and Volatile Organic Compounds. Canada, 1990.

Federal/Provincial Research and Monitoring Coordinating Committee (RMCC) 1990. *The 1990 Canadian long-range transport of air pollutants and acid deposition assessment report. Part 6 Human health effects.* Ottawa: Health and Welfare Canada.

Friends of the Earth et al. 1990. *Greening Ontario's transportation: a public campaign*. Unpublished Paper.

Garbrecht, D., 1990. Walking and Transit. *Presentations at Making Cities Liveable Conferences*. IMLC Council, Canada.

Goldemberg, J. et al. 1988. *Energy for a sustainable world*. New Delhi: John Wiley.

Hough, A.M. and Derwent, R.G. 1990. Changes in the global concentration of tropospheric ozone due to human activities. *Nature* 344, 645-648.

IBI Group 1990. *Greater Toronto Area urban structure concepts study: background report NO.3 transportation systems.* Toronto: Greater Toronto Coordinating Committee.

Institut D'Estudis Metropolitans de Barcelona 1988. *Cities: statistical, administrative and graphical information.*

Joerges, B. and Muller, H. 1983. Energy conservation programs for consumers: a comparative analysis of policy conflicts and program response in eight western countries. *Journal of Economic Psychology* 4, 1-35.

Kenworthy, J. 1989. *The land use/transit connection in Toronto: some lessons for Perth.* Unpublished paper.

Khalil, M.A.K. and Rasmussen, R.A. 1988. Carbon monoxide in the earth's atmosphere: indications of a global increase. *Nature* 322, 242-245.

Ledbetter, M. and Ross, M. 1990. *Supply curves of conserved energy for automobiles.* ACEEE (American Council for an Energy Efficient Economy).

Linzon, S.N. et al. 1984. *Ozone effects on crops in Ontario and related monetary values.* Toronto: Ontario Ministry of the Environment.

Lowe, M., 1989. *The Bicycle: Vehicle for a Small Planet.* Washington D.C.: Worldwatch Institute Paper #9.

Mackenzie, J. and Walsh, M. 1990. *Driving Forces: Motor Vehicle Trends and Their Implications for Global Warming, Energy Strategies and Transportation Planning.* World Resources Institute.

Matzoros, A. 1990. Results from a model of road traffic air pollution, featuring junction effects and vehicle operating modes. *Traffic Engineering Control vol. 31 (1).*

Meighorner, G. et al. 1984. *Environment Committee Ad Hoc Group on Transport and the Environment Activity II: case study of Munich and it's region.* Paris: OECD.

Melaragno, M. 1990. Regaining the Human Scale Through Urban Bicycling. *Presentations at the "Making Cities Liveable Conference".* IMLC Council, California.

Miller, E., et al., 1990. *Understanding Urban Travel Growth in the Greater Toronto Area.* 3 volumes, Ontario Ministry of Transportation.

Monheim, R. Pedestrianisation in German Towns. *Presentation at the "Making Cities Liveable Conferences".* IMLC Council, California.

Municipality of Metropolitan Toronto 1991. Report to the Economic Development and Planning Committee on Alternative Fuels; February 8.

Municipality of Metropolitan Toronto 1990. *Metro cordon count program - 1989.* Toronto: Metropolitan Toronto Planning Department.

Municipality of Metropolitan Toronto 1990a. *Concepts for the future G.T.A.* (draft). Toronto: Metropolitan Toronto Planning Department.

Municipality of Metropolitan Toronto 1989. *Central area monitoring program.* Toronto: Metropolitan Toronto Planning Department.

Myerson, J. 1991. *Mad Car Disease.* Greenpeace, U.K.

Newman, P. and Kenworthy, J. 1989. *Cities and automobile dependence: sourcebook.* Brookfield, Vermont: Gower Technical.

Nielson, L. 1990. *Net Community Benefits of Urban Consolidation. A Case Study of Melbourne, Australia.* Paper Presented at Globe '90 Conference.

Nishi, V. 1990. *Current issue paper #97: greenhouse effect.* Toronto: Legislative Research Services, Government of Ontario.

(OECD) Organization for Economic Cooperation and Development, *Urban Environmental Policies for the 1990s* Group on Urban Affairs, March 1990.

Ontario Ministry of Energy and Communications 1985. *Alternative Transportation Fuels: Hydrogen*. Transportation Energy Management Program (TEMP).

Ontario Ministry of the Environment 1991. Unpublished data.

Ontario Ministry of Transportation 1989. *The transportation tomorrow survey: travel survey summary for the Greater Toronto Area*. Toronto: Data Management Group, University of Toronto.

Ontario Ministry of Transportation 1989a. *Fuel Saver*, volume 6 (4).

Ontario Ministry of Transportation 1988. *The transportation tomorrow survey: an overview of travel characteristics in the Greater Toronto Area*. Toronto: Data Management Group, University of Toronto.

Ontario Ministry of Transportation 1987. *'87 Ontario road safety annual report*. Toronto.

Ontario Ministry of Transportation and Ontario Ministry of Energy 1983. *Energy conservation through transit and ridesharing*. Downsview: Transportation Energy Management Program.

Ontario Ministry of Transportation and Ontario Ministry of Energy 1983a. *Energy conservation through travel demand management*. Downsview: Transportation Energy Management Program.

Renner, M. 1988. *Rethinking the Role of the Automobile*. Washington D.C.: Worldwatch Institute.

Roberts, J., 1989. *User-Friendly Cities*. Transport Studies Unit, Oxford University.

Ross, P. 1990. Clean-air fuels for the 90's. *Popular Science*, January 1990.

Rotty, R.M. 1987. Estimates of seasonal variation in fossil fuel CO_2 emissions. *Tellus* 39B, 184-202.

Royal Commission on the Future of the Toronto Waterfront 1990. *Watershed*. Toronto.

Rutherford, B.M. and Wekerle, G.R. 1988. *Equity issues in women's accessibility to employment: transportation, location and policy*. Toronto: City of Toronto, Management Services Department.

Sassi, C. 1990. *Traffic direction in urban areas: the experience of the city of Bologna*. Paper presented to the

World Congress of Local Governments for a Sustainable Future, United Nations, September 5-8.

Special Advisory Committee on the Environment 1991. Written Communication.

Topp, H. 1990. Overall Philosophy and Mechanisms of Traffic Calming. *Presentation at the "Making Cities Liveable Conferences"*. IMLC Council, California.

Toronto Transit Commission 1989. *Transit services for disabled and elderly persons: choices for the future.* Toronto: TTC.

Toronto Transit Commission et al. 1989. *Moving forward: making transit safer for women.* Toronto: TTC.

Transport Canada and Environment Canada 1989. *A plan to identify and assess emission reduction opportunities from transportation, industrial engines and motor fuels.* Ottawa: Reference no. TP 9773E.

United Nations 1990. 1980 *Demographic yearbook.* New York: United Nations.

United Nations Environment Programme and World Health Organization 1988. *Global environment monitoring system.* London: Monitoring and Assessment Research Centre.

VHB Research and Consulting Inc., 1991. *Reduction in Energy Use and Emissions in Ontario's Transportation Sector.* Ministries of Energy, Environment and Transportation of Ontario.

Watson, A.Y. et al. (eds) 1988. *Air Pollution, the automobile and public health.* Washington, D.C.: National Academy Press.

World Meteorological Organization/United Nations Environment Programme 1990. *Scientific assessment of climate change.* Geneva: United Nations.

Yassi, A. and Friessen, B. 1990. Controlling air pollution: the plan to reduce nitrogen oxides and volatile organic compounds emission in Canada. *Canadian Journal of Public Health volume* 81.

APPENDIX 1

Members Of The Technical Workgroup

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APPENDIX 2

Terms Of Reference of the Technical Workgroup on Traffic and Vehicle Emissions

Report to:

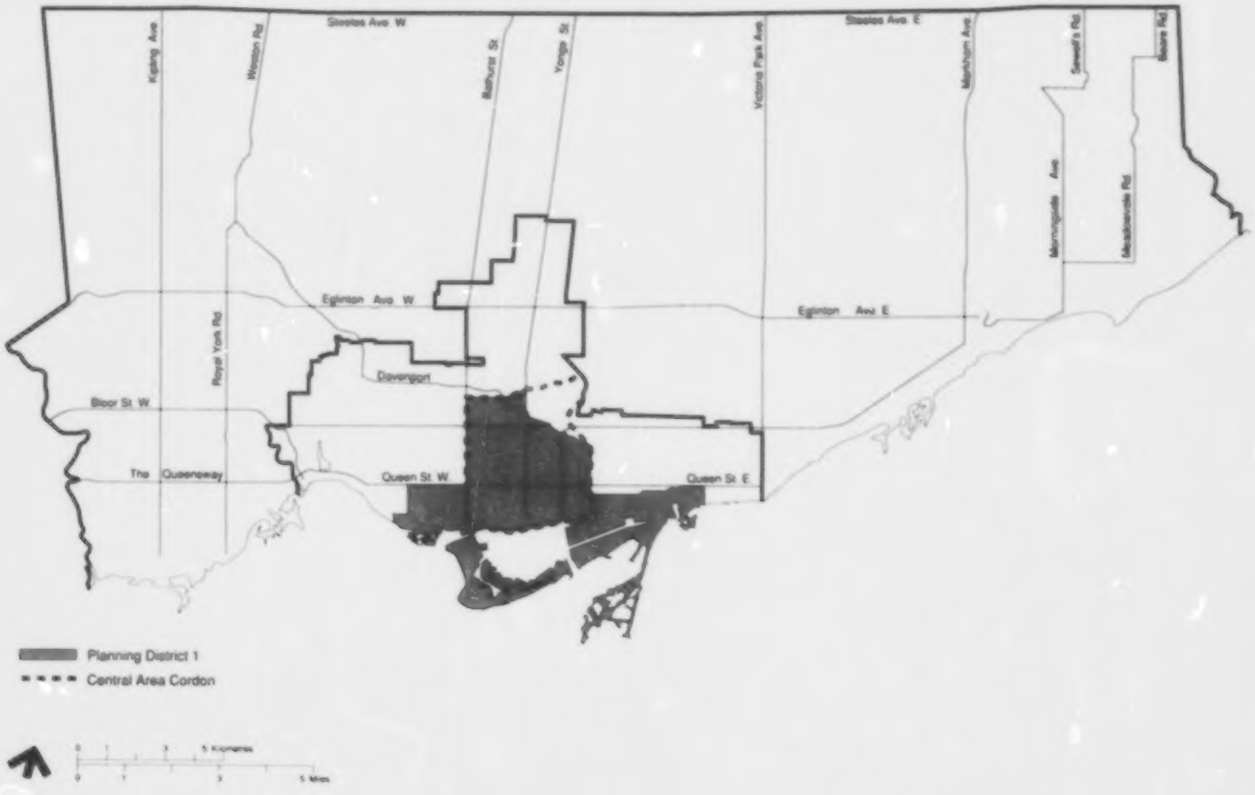
City Services Committee and Board of Health through the Committee of Heads.

Tasks

1. To assess the feasibility of traffic calming and vehicle emission reduction measures described in the report by the Medical Officer of Health (August 16, 1989) and their applicability to the City of Toronto.
2. To prepare a long-term strategy to reduce traffic and vehicle emissions in the City.
3. To develop a program to receive public community input.
4. To develop a program to receive input from the business community.
5. To develop an education program aimed at providing information on lifestyle changes necessary for an all-out attack on traffic and emission reductions.
6. To develop programs to reduce motor vehicle traffic and emissions.
7. To develop a strategy to improve alternatives to the private automobile, such as transit, bicycle and walk modes.
8. To investigate and recommend ways to expedite transit priority schemes.
9. To investigate the energy efficiency of existing vehicles with a view to encouraging the appropriate authorities to hasten the integration of more fuel efficient vehicles (including alternative fuel vehicles) into the market place.
10. To review the proposal for a Car Free Day in the context of the much broader study of reducing pollution from automobiles, buses and trucks.

APPENDIX 3

Cordons, Planning Districts and Other Borders


Kipling Ave
Weston Rd
Steeles Ave W
Bathurst St
Yonge St
Victoria Park Ave
Steeles Ave E
Markham Ave
Sewell's Rd
Beare Rd
Morningside Ave
Meadowvale Rd
Eglinton Ave W
Eglinton Ave E
Royal York Rd
Davenport
Bloor St W
The Queensway
Queen St W
Queen St E
Planning District 1
Central Area Cordon
0 1 3 5 Kilometres
0 1 3 5 Miles

APPENDIX 4

The following tables, Exhibits A4-1 and A4-2, give projections of vehicular emissions in the Greater Toronto Area under different assumptions and interventions. The first was developed by Friends of the Earth for the period from 1990 to 2005, and the second by the GTA Urban Structure Concepts Study (referred to in the report as the IBI study) extending to the year 2021. Column A of each table presents the current vehicle emission levels, column B the changes to those levels which would occur if current policies and programs continued without change, and the remaining columns present the emissions which would result under a variety of scenarios.

Under the business-as-usual scenarios, carbon dioxide emissions increase by 39% by 2005 according to the Friends of the Earth scenario, and by 75% by 2021 according to the Urban Structure Group scenario. The Friends of the Earth scenario assumes implementation of California emission standards by 1993 on all new automobiles, resulting in a decrease in NO_x and VOC emissions (although the latter begins to increase after year 2000), while the other scenario assumes present emission standards, leading to substantial emissions increases.

It should be note that only scenario D of Exhibit A4-1, in which vehicle kilometres travelled are stabilized at 1990 levels, is a 20% reduction in carbon dioxide emissions by 2005 is achieved. Such scenarios also give substantially lower NO_x and VOC emissions than for the business-as-usual scenario.

Exhibit A4-1

VEHICLE EMISSIONS TO THE YEAR 2005

Scenario	A	B	C	D	E
NO_X	63 tonnes/day	-48%	-58%	-66%	-83%
VOC	103 tonnes/day	-20%	-35%	-45%	-75%
CO_2	16.5 kilotonnes/day	+39%	+13%	-13%	-56%

All scenarios assume that the California emission standards, now proposed for Canada, are implemented in 1993; traffic projections are from Metro Planning Department 1987.

A: Current situation (1986)

B: Business as usual scenario which assumes that vehicle occupancy continues to decline at the current rate of .6% per year; average trip distance continues current increase of .5% per year in urban areas and 1% in suburban areas; modal split remains the same; average fuel economy improves 3% per year until 1992 when it levels off.

C: Freeze vehicle occupancy and suburban sprawl through policies and programs which: stop vehicle occupancy rates at 1.3 person per vehicle in urban areas and 1.55 in suburban areas; and concentrate development within existing developed areas.

D: Vehicle kilometres travelled in the GTA are stabilized at 1990 levels through policies and programs which: reduce the modal share of autos in the GTA from 73% to 68%; and increase vehicle occupancy from 1.3 to 1.4 in urban areas and from 1.55 to 1.67 in suburban areas.

E: Vehicle kilometres travelled in the GTA are cut by 50% from the 1990 levels through policies and programs which: reduce the modal share of autos in the GTA to 50%; increase vehicle occupancy to 2 persons per vehicle in urban areas and 2.4 in the suburbs; and encourage people to work closer to home, resulting in a reduction in commuting distance of .5% per year in urban areas and 1% per year in the suburbs.

Sources: Friends of the Earth et al. 1990. *Greening Ontario's transportation: a public campaign* Unpublished paper.

Municipality of Metropolitan Toronto 1987. *Transportation needs in the Greater Toronto Area.* Metro Planning Department.

Exhibit A4-2

VEHICLE EMISSIONS TO THE YEAR 2021

Scenario	A (per year)	B	C	D
NO_X	7605 kg*	+43%	+4%	+22%
HC	7696 kg	+3%	-16%	-5%
CO_2	1657233 kg	+9%	-13%	-1%
CO	86400 kg	-5%	-21%	-11%

* Emissions inventories are for the a.m. peak period

All scenarios assume that the population of the GTA will increase by 2 million by the year 2021 and that current demographic trends, social values and immigration policies will continue.

A: Current situation (1986)

B: Spread model: status quo concept with substantial population growth in the suburban regions at relatively low density; continuing concentration of office development in the downtown area and regional subcentres.

C: Central model: substantial additional intensification within the existing built up areas of the GTA; little building beyond the existing boundaries of 1989.

D: Nodal model: An intermediate concept where growth in population and employment occurs around and within existing communities throughout the GTA.

Source: IBI Group 1990. *Greater Toronto Area urban structure concepts study: background report NO.3 transportation systems.* Toronto: Greater Toronto Coordinating Committee.

APPENDIX 5

Discussion Of Transit Priority Measures

In Section 3 we recommend that City Council restrict driving on streetcar tracks and undertake other measures to improve the speed of streetcar service, accompanied by the creation of dedicated bus lanes on major non-streetcar routes. These measures could be implemented initially only during rush periods but with the intention of eventually extending the restriction to 14-16 hours per day. In this Appendix we discuss some of the issues arising from our recommendations. In Appendix 6 we present an analysis of the potential of shifting automobile commuters to public transit as a result of the measures we recommend.

There is already a programmed three to five minute headway on all streetcar routes during rush hours. Delays in streetcar flow, leading to longer headway, are almost always a result of traffic congestion. The measures proposed here will significantly improve both the reliability and speed of streetcar service.

Exhibit A5-1 shows the average A.M. and P.M. peak period streetcar travel times on Queen Street between Bathurst and Parliament, as well as the component of travel time due to passenger loading and unloading, waiting for traffic signals, and delays caused by traffic congestion as given in the TTC 1988 Transit Priority Study. In interpreting these data, it is important to note that (a) much of what is counted as "signal delay" is in fact traffic delay, because signal delay is defined in the Transit Priority Study as including queue dispersion time after a red phase (which would be eliminated if non-transit vehicles are prohibited from driving on streetcar tracks) and vehicles turning left or right at signalized intersections (only vehicles turning at non-signalized intersections count as traffic delay); (b) "delay" is counted only when the streetcar slows to less than a walking speed (hence, times when vehicles are significantly slowed due to traffic congestion but still move faster than a walking pace are not counted as delay); and (c) most of the "traffic" delay for the P.M. rush hour was caused by a parade on Bay street which occurred at the same time as the survey.

In light of these definitions and caveats, we shall disregard the P.M. traffic delay data. The combined signal and passenger loading delays for both rush hour periods and in both directions amount to 40-43% of the total travel time (excluding that portion of the P.M. travel times due to the parade). If, as seems reasonable, the measures that we propose reduce this delay by half, then total travel times will be reduced by about 20%. However, as noted above, delay due to traffic congestion between intersections is not reflected in the data presented in Exhibit A5-1. Elimination of this delay, along with a halving of passenger service and signal delay, could reduce total travel time by 30-40%. It would be useful to have more data, collected from a number of streetcar routes and under a variety of traffic and weather conditions, so at to be able to refine this admittedly crude estimate.

Exhibit A5-1

SPEED AND DELAY SUMMARY *Queen Street Car - Bathurst to Parliament*

	Total Time	Passenger Service	Signal Delay	Traffic Delay
AM Peak Eastbound	14'13"	2'06"	3'55"	0'0"
AM Peak WB	15'14"	2'24"	3'45"	0'05"
PM Peak EB	24'56"	3'43"	4'13"	6'35"
PM Peak WB	21'50"	3'43"	4'27"	2'07"

If the reduction in travel time is only 30% then, as noted in the body of this report, a 30% reduction in the headway and a 30% increase in the passenger carrying capacity would occur with no increase in the number of streetcars in service during rush hour, assuming the same number of passengers per streetcar as at present. The automobile-streetcar modal split on Queen Street ranges from 24:76 to 35:65. Using an average split of 30:70, an increase in streetcar commuters by only 20% corresponds to a 50% decrease in automobile commuters if the streetcar increases occur as a result of shifting commuters from automobile to transit. Similarly, an increase in the speed with which buses travel on bus routes leads to a proportional increase in the number of passengers that can be carried without purchasing additional buses. Thus, a significant portion of the additional TTC passengers resulting from a 50% reduction in automobile vehicle-kilometres travelled could be achieved with present passenger loadings per streetcar or bus and no increase in the number of streetcars or buses, simply by making them flow faster as a result of the measures proposed here. This represents an unusual opportunity for City Council to address a set of pressing environmental and transportation issues with almost no additional expenditure of tax dollars required.

The greater passenger volume facilitated by, and attracted to, faster flowing transit vehicles would generate further revenues, which could then be used to purchase additional vehicles, thereby further improving transit service and attracting further passengers. We see the transit priority measures which we recommend as leading to a positive feedback which could greatly enhance the attractiveness and capacity of the City's surface public transit.

With traffic banned from driving on streetcar tracks, rapid loading and unloading of streetcars, and traffic light priority for streetcars, the Broadview-King-Roncesvalles streetcar line could serve as a downtown "relief line" until and if the Queen Street subway is built. However, it could function as such only if all of these measures are implemented along the entire route.

A number of options are available to mitigate the adverse effects of streetcar traffic light priority on traffic in the cross-flow direction. Two options which would not adversely affect streetcar service, and therefore merit consideration, are to (a) temporarily suspend streetcar signal priority after the first streetcar if two or more streetcars arrive at an intersection from the same direction in quick succession, and (b) allow a longer green phase for the cross-flow direction during the first cycle after which the cross-flow direction has experienced a shortened green phase.

An alternative to keeping green lights green when a streetcar approaches is to have the light turn red, on the assumption that the streetcar would have to stop anyway at all intersections during rush hour, and given that automobiles also have to stop in any case when passenger loading and unloading is occurring. If this were done, provision would have to made such that the streetcar conductor could signal the light to turn green just before he or she is ready to continue.

Left hand turns at a limited number of intersections, with streetcar control of left turn-only phases, should be implemented in the long term only if they do not interfere with the efficient flow of streetcars, as streetcars must be given absolute priority over automobile traffic.

Allowing middle door loading and unloading of passengers will require some proof of purchase system (perhaps simply transfers) with random checks; this system is currently in place along the Queen Street route. In the longer term, it might also be necessary to make new vehicles with wider rear doors than at present.

The rationale behind a system-wide transfer system in which patrons can break their journey without paying another fare, is to remove a possible disincentive to using the TTC instead of the automobile by making it possible to stop briefly at a store on the way home with no more delay or expense than using the automobile. One might object to such a system on the grounds that it would undermine the monthly pass system, and this potential impact should be assessed. The target group for this recommendation are those individuals who own cars but who would never use the TTC often enough, even in the absence of their cars, to justify purchase of a monthly pass. A system-wide transfer system would provide an incentive to such people to use the TTC rather than their cars for occasional multi-purpose trips within the city. An alternative would be to make the day pass cheaper.

The rationale for a continuous streetcar route from Bathurst onto Dundas, Queen, or King is to provide a rapid alternative to taking the University or Yonge subway lines from the Bloor subway line to get into the downtown core, without requiring more changes of transit vehicle than if the passenger transferred from the Bloor subway to the University or Yonge subway. Surveys have shown that passengers are particularly sensitive to the number of times that they must change transit vehicle during their journey. The Bloor-Yonge interchange as well as the Yonge line south of Bloor is heavily congested during rush hour, while the Bathurst streetcar line is presently underused, having a 5 minute headway. A continuous Bathurst-Dundas/Queen/or King streetcar route, free of traffic impediments and with traffic light priority, could relieve some of the subway congestion. Although this proposal departs from the grid structure characteristic of the TTC, there are already a number of exceptions, such as the Leslie Street bus feeding into Eglinton subway station. Inasmuch as we are seeking to transfer a large fraction of commuters who presently commute by automobile to TTC, there may be a need for this proposal even after the urgently needed Spadina LRT is built.

Reference: Toronto Transit Commission 1988. *Transit priority study*.

APPENDIX 6

Balancing The Loss of Road Space for Automobiles Against Reductions in Automobile Use

In Chapter 3, we recommended that driving on streetcar tracks be prohibited, initially during rush hours only. As well, we recommended creation of lanes for buses and bicycles only on other major routes. There are a number of inter-related issues pertaining to these recommendations. Prohibition of driving of streetcar tracks, and what would become bus lanes, will reduce the traffic capacity of the roads and will increase congestion of non-streetcar vehicles if there is not a compensating decrease in the volume of traffic. This is a legitimate and important consideration for commercial vehicles. The increased speed of the streetcar and bus service will result in increased capacity to carry commuters even without purchasing additional streetcars, and will attract some commuters who currently use their automobiles. Key questions are (1) are there enough automobile commuters living in the City of Toronto or well served by TTC/GO such that, if they switched to TTC/GO, the reduction in automobile use would be enough to compensate for the loss of the privilege to drive on streetcar tracks, and (2) if the answer to (1) is yes, would the increased speed of streetcar service, combined with other feasible measures, be sufficient to shift enough of these commuters to TTC so that traffic congestion would not worsen?

A rigorous answer to either of these question requires considerable data acquisition and detailed modelling of traffic flow, neither of which fall within the scope of the present committee. We therefore make use of available data in order to get a rough indication of the feasibility of balancing streetcar and bus priority measures, increased use of streetcars and buses, and reduced traffic volumes. Data are not available for the entire region served by streetcars without including other areas, so we use data for the Central Area as a rough indicator of the potential for reducing automobile traffic within the area served by streetcars. The following is intended only for discussion purposes and to prompt detailed modelling.

Exhibit A6-1 shows the number of trips into the Central Area during the AM peak period originating from Planning Districts (PD's) 1,2, and 6, PD's 3, 4, and 5, the total of PD's 1 to 6, all other regions, and the total.

The breakdown of these trips by mode is also given. It is seen that about 30% of those commuting into the Central Area do so by automobile.

Suppose that prohibition of driving on streetcar tracks reduces the non-streetcar traffic capacity by 40%. The overall capacity reduction in the east-west direction might be about 30-40%, depending on the number of dedicated bus lanes added to non-streetcar routes in the east-west direction. The capacity reduction in the north-south direction is likely to be smaller than in the east-west direction since routes like Yonge Street would not require express bus lanes and routes such as Jarvis Street would lose only one lane in three for the rush hour direction.

Suppose that a reduction in traffic volume of 35% is required to compensate for the measures proposed here. It is seen from Table A6-1 that about 50% of the cars in the Central Area come from PD's 1 to 6, which are very accessible to the Central Area and to each other by TTC. Thus, there seem to be enough automobile commuters by choice rather than of necessity that the required reductions in traffic volume could occur if the right incentives/disincentives were given. As well, some of the automobile commuters from outside PD's 1-6 could be shifted to TTC/GO by implementing some of the short term measures proposed elsewhere in this report.

Exhibit A6-1

TRIPS INTO THE CENTRAL AREA[1] *AM Peak Period*

Origin	Auto	TTC	GO	Walk/Bike	Total
PD's 1,2,6	30,600 (29%)	53,800	100	17,900	105,100
PD's 3,4,5	24,400 (34%)	43,100	300	1,400	72,100
PD's 1-6	55,000 (31%)	97,000	400	19,300	177,200
Other	57,400 (32%)	67,300	22,800	100	180,800
Total	112,400 (31%)	164,300	23,200	19,400	358,000

1. Totals given for each row also include a fourth category of riders who do not drive, take transit, walk or cycle.

By way of illustration, a 60% reduction in automobile trips from PD's 1, 2, and 6, a 45% reduction from PD's 3, 4, and 5, and an 18% reduction in automobile trips from outside PD's 1-6 would give a net reduction in automobile trips to the Central Area of 35%. Detailed modelling is required to determine the implications of these reductions in automobile trips for required passenger capacity increases on subways, buses, and GO transit. We have already argued that the increased speed of streetcars alone would be sufficient to compensate for some and perhaps all of the increased passenger load on the streetcar part of the system, with any remainder accommodated by an increase in the number of streetcars. Furthermore, if the Broadview-King-Roncesvalles line serves as an alternative to the Yonge subway up to the Bloor-Danforth line, this would allow some increase in passengers using the subway for at least part of their trip. As well, some of the required decrease in automobile traffic could be accommodated by an increase in automobile occupancy or by some commuters shifting to bicycling.

The 60%, 45%, and 18% reductions in automobile trips originating from PD's 1-2-6, 3-4-5, and outside these zones, respectively, correspond to increases in TTC/GO use of 34%, 26%, and 10%, respectively, if all of the former automobile commuters switch to TTC/GO (in reality, some would switch to car-pooling or cycling). The TTC's elasticity data bank analysis suggests an elasticity for transit time of 0.25 in the short run and 0.5 in the long run, meaning that a 30% decrease in transit time (estimated above to result from the proposed streetcar priority measures) would increase demand by 7.5-15%. The cross-elasticity for the cost of commuting by automobile is estimated to be 0.25, so that a doubling of automobile trip costs increases demand for public transit by 25%, while the cross elasticity for automobile travel time is estimated to be 0.3. The measures proposed here will almost certainly increase automobile travel times initially, which will tend to shift commuters to transit but at the same time tend to reverse the increase in automobile travel time. Efforts must therefore be made to maintain passengers who switch during the early transition period purely out of frustration with automobile congestion. Increasing the comfort of streetcars (ie.: less crowded conditions, air conditioning), decreasing the uncertainty of travel times (a byproduct of the measures proposed here), and strong public promotion would likely help in increasing and maintaining higher levels of TTC use. What is not known is the effect of simultaneously implementing a number of measures to increase TTC use. It is likely that the net effect of implementing many measures at once is greater than the sum of the effects of individual measures, since tolerance thresholds are more likely to be crossed. Nevertheless, it is clear that strong measures will be needed to get the reductions in automobile use of the magnitude discussed here.

Finally, we note that if measures aimed at inducing a large number of automobile commuters to switch to public transit (or bicycles) were successful, the reduced vehicular congestion might induce some people back to their cars. For this reason alone, the road space available to automobiles must be decreased as part of a strategy to reduce traffic volume. Such a decrease in road space for automobiles must occur anyway, as part of the very strategy outlined here to make non-automobile modes of travel (public transit and bicycles) more attractive.

Source: Municipality of Metropolitan Toronto 1990. *Central Area Monitoring Program*. Toronto: Metropolitan Planning Department.

APPENDIX 7

Transit Priority Signal

This system allows the 'green' phase of the traffic light to be extended while the public transit vehicle loads or unloads the passengers. Currently, the TTC is testing such a system on a portion of Queen Street West. The results of the study will be available in the spring of 1991. The system works in the following ways:

a) if a light is already green when a streetcar stops to pick up /unload passengers, it remains green until the streetcar has crossed the intersection;

b) if a light is red when a streetcar reaches the intersection, the red phase is shortened so as to permit earlier passage of the streetcar; and

c) at intersections where left hand turns are permitted, the streetcar triggers a left-turn only traffic phase so as to clear vehicles out of the intersection as the streetcar approaches the intersection.

Source: Toronto Transit Commission 1990. Written communication.

APPENDIX 8

Report of the Transit Advisory Group

Recommendation 1:

OBJECTIVES

The following objectives should be adopted for the improvement of inter-regional transit service in the Greater Toronto Area.

INCREASE FARE INTEGRATION

Fare integration should be increased so as to make trips involving two or more transit jurisdictions more attractive and convenient. Particular attention should be given to reducing the annoyance of being charged a full second fare for a short additional ride.

IMPROVE SERVICE COORDINATION

Service coordination between the different transit operators should be improved in the interest of serving cross-boundary travellers better and increasing the modal split.

Opportunities for possible savings through a pooled approach on matters such as maintenance, staff training, etc., should also be explored. Such savings would benefit the riders indirectly.

IMPROVE PLANNING COORDINATION

Planning coordation should be improved so as to rationalize the planning initiatives of individual jurisdictions in the best interests of the area as a whole. Procedures should be established involving consultation that starts early in the planning process rather than after the plans are prepared.

IMPROVE COORDINATION OF TRANSIT SERVICES FOR DISABLED PERSONS

Coordination of special transit services for disabled persons should be improved in ways similar to those recommended for regular transit.

ENCOURAGE LAND USE PATTERNS THAT ARE MORE TRANSIT ORIENTED

Land use patterns and densities that are more transit oriented should be encouraged. To help bring this about, the Minister should initiate discussions with other ministries and with regional and municipal planning staffs to find ways to ensure that the requirements for effective transit operation and the needs of transit users are taken into consideration in municipal land use decisions. The Minister should also arrange to have the Ministry of Municipal Affairs involved in the early stages of discussions on all transit proposals that will affect land use.

ENCOURAGE THE DEVELOPMENT OF REGIONAL TRANSIT SYSTEMS

The development of regional transit systems should be encouraged. Existing financial disincentives to the merger of local systems in Durham, York, Peel and Halton should be eliminated. The successful development of regional transit in Hamilton-Wentworth should be used as a model to allay concerns about the provision of uneconomic routes and the allocation of operating costs to areas not benefiting from transit services.

ELICIT CONSUMER INPUT

Improved and ongoing arrangements should be established to encourage and respond to input from transit users and consumer groups, especially in the early stages of transit planning.

COORDINATE THE GATHERING, ANALYSIS AND DISTRIBUTION OF INFORMATION ON TRANSIT

The collection and analysis of transit data and the undertaking of research on transit issues should be coordinated, and a central repository for transit planning and monitoring information should be established in the Greater Toronto Area.

IMPROVE OVERALL COST-EFFECTIVENESS

In recognition of the limits on available financial resources, efforts to improve the overall cost-effectiveness of transit spending should be strengthened. Such efforts should include the exploration of opportunities to cut costs and increase efficiency through greater involvement of the private sector.

Recommendation 2:

ORGANIZATION

The above objectives will have to be effectively pursued if the challenges are to be met. Ministry of Transportation leadership assisted by an inter-regional transit coordinating agency is recommended as the most appropriate institutional arrangement for doing so. We therefore, recommend that:

> The Ministry of Transportation should assume a more active role in inter-regional transit coordination in the Greater Toronto Area, and the Minister should establish an Inter-Regional Transit Coordinating Agency (ITCA) with its own staff to assist him in the fulfilment of this role.

Recommendation 3:

RESPONSIBILITIES

The ITCA should be responsible for advising the Minister on ways to improve the coordination of cross-boundary transit in the Greater Toronto Area, with special reference to the objectives defined in recommendation 1. The ITCA should also play the role of transit advocate throughout the area.

Recommendation 4:

STRUCTURE

AREA OF JURISDICTION

The area of jurisdiction of the ITCA should cover the Greater Toronto Area, including but not limited to Metropolitan Toronto and the Regions of Durham, York, Peel, Halton and Hamilton-Wentworth, and encompassing the GO Transit Service Area. The area of jurisdiction should be reviewed periodically by the Minister for possible extension within the Greater Toronto Area commutershed.

COMPOSITION OF THE BOARD

It is essential that the members of the coordinating agency take an area-wide view. For that reason, they should be citizens at large and not representatives of individual municipalities. As their role is only to advise the provincial government which already represents the people of the area, they do not need to be elected representatives. It is expected that the Minister will consult with Regional representatives on appointments to the board.

Accordingly, the following composition is proposed for the board:

> The ITCA should have a board of directors composed of individuals appointed by the Minister. The board should consist of a chairman and 4 members serving on a part-time basis. Their terms of office and remuneration should be set in accordance with provincial standards for agencies of a similar nature.

STAFF AND BUDGET

The agency should have its own full-time staff headed by an experienced chief executive officer, and should be given sufficient financial resources to fulfil its responsibilities.

Recommendation 5: PROCEDURES

REVIEW OF CAPITAL AND OPERATING PLANS

The ITCA in cooperation with provincial agencies, the municipalities and the transit operators should establish a procedure for consultation starting early in the planning process, so as to achieve coordination as plans are developed.

CONSULTATION WITH OTHERS

The ITCA should seek input from others concerned with transit coordination, and provide information to them. Those consulted should include:

- transit users and consumer groups
- the general public
- special interest groups, including those representing disabled persons
- any other organization concerned with transit coordination

The ITCA Board should establish a permanent advisory committee of transit users and consumer representatives.

RESEARCH

The ITCA should coordinate data collection and analysis in the area, and should also undertake research on transit coordination, initiate studies, gather necessary data, and carry out independent reviews as directed by the Minister. As a result of these activities, the agency should become the central repository and distribution centre for transit planning and monitoring information in the Greater Toronto Area.

REVIEW OF SUBSIDY POLICIES

The ITCA should review provincial subsidy policies to determine how subsidies can best be used to encourage transit coordination.

Recommendation 6: **IMPLEMENTATION**

Since a few of the challenges facing the area are considered serious and urgent and the others will become so if they are not acted on soon, implementation of the above proposals should proceed as quickly as possible.

Recommendation 7: **REVIEW OF PROGRESS**

The foregoing recommendations, if implemented, will establish a new institutional arrangement for transit coordination in the Greater Toronto Area. It will be important to review the progress of the new arrangement after a reasonable time to determine its effectiveness. Accordingly, our final recommendation is that:

> *The Minister should review the accomplishments of the new institutional arrangement within five years of the time that it becomes operational.*

Source: Ontario Ministry of Transportation 1988. *Crossing the boundaries*. Report of the Transit Advisory Group.

APPENDIX 9

Go Transit Long Term Service Strategy

For the foreseeable future, GO Transit's long term service strategy will be guided by the following principles:

-In the absence of specific directives from the Minister of Transportation, GO Transit will:

1. Respond incrementally to transportation demands both in the peak and off-peak periods.
2. Maximize use of existing equipment and plant to ensure the optimum productivity of our assets.
3. Expand plant incrementally as required to remove service impediments to a pre-defined quality of service.
4. Identify new markets in periods for which existing capacity is available.
5. Identify and protect potential new station/terminal sites.
6. Respond incrementally to new equipment acquisition demands consistent with passenger demand and optimum productive use of GO's existing equipment assets.
7. Upgrade equipment from time to time, consistent with good financial management in order to ensure equipment reliability at a level necessary to ensure a pre-defined quality of service.

-Provide to the Ministry of Transportation, from time to time, for its consideration, GO Transit's view of the inter-regional passenger networks necessary to adequately service our mandated area of service.

-Respond to specific directives from the Minister.

In the context of the long term service strategy, GO Transit is of the view that electrification of the system is a possibility, however, it would be a long term consideration that should be based on a conventional business case analysis and justification.

If, however, this magnitude of provincial funding is to be made available for environmental reasons, GO Transit is of the opinion that the funding would be more cost effective from an emission reduction perspective if it was directed to the upgrading of the train capacity of the existing rail train operation corridors, and acquiring new rail operating corridors within the Greater Toronto Area. Such an approach would provide the opportunity to increase market share by capturing existing private automobile travellers.

Source: GO transit 1990. Written communication.

APPENDIX 10

A Transportation Vision

As an indication of the magnitude of public transit investments that we believe are required to address Toronto-area transportation and related environmental problems, and to stimulate discussion, we present the following vision of a comprehensive system of rapid, intermediate to high capacity transit lines within Metro Toronto:

- at least two major east-west lines across the central and northern parts of Metro Toronto, such as a Shepherd line running between Scarborough Town Centre and northern Etobicoke and an Eglinton line from the Airport to the Eglinton Avenue GO station in Scarborough;
- a Queen Street relief line[1] from High Park to Kingston road or thereabouts, linking back with the Bloor-Danforth subway line at both ends;
- a north-south mid-Etobicoke line which would link the Bloor, central Metro, and north Metro east-west lines, so that commuters on both the Bloor and north-Metro lines can reach the airport by the central line;
- an extension of the Spadina line to York University at Steeles, and possibly to the Hwy 407/400 interchange;
- a line running north from where the Queen line intersects the Bloor Subway near High Park; possibly running along Keele Street or Jane Street and extending as far as York University, where it could link with the extension of the Spadina line at York University;
- a line running north from where the east end of the Queen line intersects the Danforth subway, possibly along Victoria Park Avenue.

These expansions would complement our proposals elsewhere to make full use of the existing rail corridors, including the mid town CP line, as well as proposals to expand the city's streetcar network and integrate it with GO and subway lines. We are not presenting the above as a statement of the specific routes that should be built, but rather, simply to present a vision of a dramatically expanded rapid transit infrastructure in order to stimulate discussion.

[1] A subway station for a Queen Street line was built below the Yonge Subway line in the 1970's but was sealed off after plans to build a Queen Street line then were abandoned.

The important principles which should guide any rapid transit expansion are:

1) to build network flexibility;
2) to build a comprehensive grid of rapid transit lines;
3) to build in links with transit systems outside Metro Toronto; and
4) to provide convenient access to the airport and major institutions. Possible linkages to Hwy 407 would reduce need for north-south road links, and the savings would constitute a credit against the cost of the rapid transit.

An important consideration in any rapid transit system expansion should be to physically integrate GO transit with the rapid transit system. Ideally, subway and GO trains travelling in the same direction should share opposite sides of the same platform, or one should be placed vertically above the other (as in the Bloor and Spadina subway lines at St. George station).

APPENDIX 11

Alternative Fuels

INTRODUCTION

The search for alternate fuels to replace petroleum as the energy source used in the internal combustion engine was initiated by the realization that fossil fuels are ultimately infinite supply. The search is now spurred by the need to find an alternate energy source that does not release carbon dioxide and other environmentally threatening pollutants.

The commonly recognized alternate fuels, as discussed below, include: compressed natural gas (CNC); alcohol (methanol and ethanol); propane; hydrogen (industrial and solar); electric-battery; solar-battery; and methane-ammonia fuel systems.

The assessments of the various alternate fuels are often beset by conflicting conclusions. Any material that burns can provide the power to move a vehicle, however, most such materials have severe practical restrictions to their use including public safety, weight-volume-efficiency, and quality of the related gaseous and particulate emissions.

Some fuels may provide practical benefit in the short term (natural gas, methanol and propane) whereas others such as hydrogen, ammonia, and electric (battery) may present benefits that are only realized in the longer term. (Municipality of Metropolitan Toronto 1991)

No assessment of alternate fuels can remain current for long. Just as technology moves forward in this area, so too do the relative cost determinations of the various fuels change with the global supply of these goods. Each alternate fuel will become more cost effective as the associated costs of producing and using the fuel are lowered in relation to oil. Propane is competitive with gasoline today. Compressed natural gas and alcohol based fuels from natural gas may be expected to become more cost effective.

PROPANE

Propane is derived from natural gas and crude oil during the refining of gasoline. It is effectively a by-product, but one that could be made in greater quantity within the same process if required. Propane is clean burning and efficient and has been used in automotive vehicles in Ontario for several years. Propane as an automotive fuel is not pure propane (C3H8) but is a mixture of hydrocarbons also commonly known as liquified petroleum gas (LPG); usually less than 10% of such other hydrocarbons as Butane and Propylene are present. Commercial grade propane as commonly used for heating or other purposes is not acceptable as an automotive fuel because of its very low octane value.

Use of propane as an automotive fuel is far from being a new idea. It has been used as such for over 40 years. Where environmental concerns prohibit the use of other dirtier fuels, such as in factory based fork-lift vehicles, it has been especially useful.

The use of propane in gasoline-powered automobiles requires a small number of fairly minor modifications to the vehicle: the addition of a special heavy gauge steel pressure resistant storage tank, and adjustments to the ignition timing, carburettor, and fuel delivery system. The energy density of gaseous propane is very low and the gas has to be converted to liquid and stored under pressure to be used as an automotive fuel.

Propane has the following advantages:

a) propane has a high octane value, and, therefore, can permit use of higher compression ratios, resulting in greater energy efficiencies, and smaller engine sizes;
b) propane is cheaper than gasoline;
c) propane has a widening distribution network;
d) existing vehicles can be converted to run on propane;
e) it burns more completely than gasoline and, therefore, its emissions of carbon monoxide and unburnt hydrocarbons are also lower than that of gasoline;
f) it is non-toxic and relatively safe to use;

g) it produces less spark plug fouling, smoother throttle response, and easier cold starting than gasoline; and

h) propane tanks are less likely to suffer injury during minor accidents, and in the event of vehicle fires, propane tanks are less likely to explode than gasoline tanks (because they have relief valves), any flame jet should also be easier to control than a flaming gasoline fuel spill.

Propane has the following disadvantages:

a) it only contains about 75% of the equivalent energy of gasoline per unit volume;

b) initial conversion costs can be considerable;

c) potentially pressurized propane could escape from the vehicle's fuel delivery system;

d) considerably less trunk space (especially in smaller cars); and

e) reduced availability in comparison to gasoline.

NATURAL GAS

Natural gas is known as either compressed natural gas (CNG) or natural gas for vehicles (NGV). While in Western Canada, CNG has become the fuel of choice for future energy needs, (heating, electricity production, et cetera) it would unlikely satisfy all our energy demands at the present rate of production. Indeed, demand could far exceed not only the supply but the known reserves as well. However, the supply of natural gas is not as prone to supply and price disruptions as is gasoline derived from crude oil.

CNG has a number of advantages over gasoline as an automotive fuel in Ontario. These include:

a) CNG is "sellable" to the public as a high performance fuel with a higher octane rating than gasoline, and engines operate very smoothly when using it;

b) CNG is a clean burning fuel with lower hydrocarbon emissions (between 40 and 90% less), lower carbon monoxide emissions (between 50 and 60% less), and lower carbon dioxide emissions (approximately 10% less) than gasoline;

c) CNG is priced at about half the cost of gasoline on an energy-equivalent basis; and

d) CNG already has an effective distribution system in place.

The disadvantages to its use include:

a) CNG storage and the process of supplying CNG to vehicles is still problematic, although it has been resolved satisfactorily for the approximately 20,000 vehicles (mostly fleet vehicles) that run on CNG in Canada;

b) CNG requires a very heavy and cumbersome fuel tank that takes longer to fill than gasoline;

c) CNG requires spark advance modifications to permit use in a gasoline engine; and

d) CNG is not as energy efficient per unit volume as gasoline. Therefore, it requires more frequent fill-ups, or the introduction of additional heavy tanks with the accompanying loss of fuel efficiency (because the vehicle is heavier).

ALCOHOL BASED FUELS (METHANOL & ETHANOL)

There are two alcohol based fuels: methanol (also known as wood alcohol, methyl alcohol, or methyl hydrate) and ethanol (also known as grain alcohol and ethyl alcohol). Methanol is most commonly derived from natural gas. Ethanol is most commonly derived from field crops and has been used as a beverage for centuries. Both methanol and ethanol can be used in a "neat" state or as a blend with gasoline. Blending produces both advantages and disadvantages.

The advantages of using alcohol based fuels include:

a) alcohol blends are broadly compatible with the existing internal combustion engine and could be distributed in much the same manner and be put into gas tanks of existing vehicles without having to modify them (gasoline and alcohol should be stored separately either at gas stations and blended at time of sale, or at distribution terminals and blended at the time of shipping);

b) neat alcohol has higher octane ratings than gasoline and, therefore, permits use of higher compression ratios, greater energy efficiency, and thus more power from smaller engines; and

c) alcohol produces less NOx than gasoline.

The often repeated advantage that carbon monoxide emissions are reduced using ethanol as an additive to gasoline is also true, but when used as a prime ingredient the emissions are about the same (90%) as those from gasoline.

The associated disadvantages include:

a) safety problems of methanol, as during accidents, when it may burn with an almost invisible blue flame;

b) larger fuel tanks for equivalent driving range;

c) low cetane number (the measure of the ignition capability of a fuel in a compression-ignition engine) and therefore, cold start problems;

d) very large quantities of raw material needed to produce adequate supply of ethanol (if 100% of all grain produced in USA were to be turned each year into ethanol, it would provide approximately 25% of fuel requirements); and

e) phase separation in the gas tank can result in an upper gasoline-rich phase, containing very little alcohol and only traces of water, and a lower alcohol/water phase containing most of the contaminating water and a greatly reduced amount of gasoline (may also lead to fuel line freezing).

The advantages of using blends relates to the reduction or avoidance of the associated disadvantages of using neat fuel. By adding gasoline to methanol, it can more readily be seen when burning (burns with bright yellow flame like gas). Additions of 15% gasoline to produce M85 (methanol 85%) will permit a vehicle to start at -15oC whereas neat methanol (M100) causes difficult starting at 10oC. On the other hand, whereas M100 has 90% lower unburnt hydrocarbon emissions than gasoline, M85 has only 35% lower emissions.

Ethanol has some advantages over methanol, such as ease of mixing with gasoline and a higher energy density, and is less corrosive than methanol. However, methanol is less energy intensive in its production than ethanol.

Both ethanol and methanol fuels are used elsewhere in the world. Methanol is also the fuel used in certain cars used for racing (eg the Molson Indy race in Toronto each year). Brazil adopted an ethanol program after the 1973 fuel crisis. Brazil planned to use its vast sugar cane crop as a source of the ethanol. Ten years later (by 1983) 10% of Brazil's existing vehicles were using neat ethanol, and the remainder used E20 (80% gasoline plus 20% ethanol). Ethanol blends have also been used in the USA, and in Manitoba (E10). Methanol blends (M2-3) have also been used in Germany.

ELECTRIC-BATTERY

The electric vehicle is touted as the clean vehicle. Indeed at the point of energy consumption, the vehicle is remarkably "clean". The question is, however, how was the electricity initially produced? If produced by the burning of fossil fuels, then the total emission output must be considered.

The advantages of an electric-battery powered vehicle include:

a) they are quieter than gasoline engines;
b) they produce negligible "at vehicle" emissions;
c) they can be made to produce sports car like performance (at a cost of distance travelled between recharging batteries);
d) there is a very wide network of electricity providing outlets in place (every home could charge its own); and
e) electric motors are mechanically simple, less prone to failure, and relatively easy to maintain in comparison to gasoline units.

The disadvantages of an electric-powered vehicle include:

a) electric vehicles are heavy because of the great number of batteries that have to be carried;

b) electric vehicles are much more expensive at present than gasoline equivalents (recently up to 400% more);

c) a much reduced driving range and for the most part (advantage "c" above notwithstanding) and a much lower speed of travel (making it better suited to urban travel than highway use);

d) long recharge time (up to 8 hours) and few quick boost outlets yet available;

e) high cost of battery replacement; and

f) smaller interior dimensions to vehicles (because batteries consumes space).

ELECTRIC-SOLAR

Unfortunately, Canada's geographic position with respect to the "concentration" of incoming solar radiation (insolation) per unit area of horizontal surface makes it an unlikely place to see solar powered-vehicles performing sufficiently strongly. The concept of electric-solar can only apply realistically to those cases whereby solar energy is collected in large solar panel (photovoltaic) arrays and stored in electric-battery cells. This is unlikely to provide realistic possibilities for widespread employment as an alternate to standard automotive technologies or to be considered alongside the more established alternate fuel possibilities.

However, as a "free energy source" and a pollution free fuel (manufacture of photovoltaics notwithstanding) such possibilities, as fictional as they may appear at present, remain attractive avenues for further research.

AMMONIA

As suggested above, any material that burns can provide the power to move a vehicle, however, most such materials have severe practical restrictions to their use. Ammonia burns and has been used to drive vehicles. Its big advantage is that being composed of nitrogen and hydrogen it contains no carbon, and, therefore, produces only negligible quantities of carbon monoxide and carbon dioxide at the tail pipe.

Ammonia does not naturally occur in large quantities or in readily available forms. It has to be produced from feedstocks, as it is for artificial fertilizer.

While several attempts were made to evaluate the use of ammonia as an automotive fuel (as in Manitoba several years ago), no results were seemingly ever published. As such, no credible data or assessment is known to exist for this potential automotive alternate fuel source.

HYDROGEN

Hydrogen is promoted as the ecologically preferred fuel because the only significant emission to come from the tailpipe is water vapour. The small amounts of NOx which are co-produced at the same time as the hydrogen and oxygen combine are usually discounted as insignificant. Water vapour also traps outgoing longwave radiation from the earth - in the same manner as does carbon dioxide, though for a slightly different wavelength of the atmospheric window - but it is not considered to be an environmental hazard.

While hydrogen is also very abundant, it is invariably combined with other elements, from which it has to be separated, before being used as a fuel. As a fuel source, it recombines with oxygen, under appropriate conditions, to produce the energy to propel vehicles. This should not necessarily be viewed as the ultimate panacea unless the water vapour is captured and reused.[1]

Hydrogen may be produced in a number of ways from a variety of sources. The two major commercial processes are the steam-reforming of hydrocarbons, such as methane, and the electrolysis of water. Other processes, still in the research and development or experimental stage, involve thermo-chemical, photo-chemical and photelectochemical, and photobiological production methods. Hydrogen is produced in Ontario at oil refineries through the steam-methane reforming of natural gas. In the longer term it may become less expensive to produce hydrogen by electrolysis, but it would be necessary to use nuclear-generated electricity to do it.

[1] It has to be remembered that the consumption of oxygen from the atmosphere can not continue unchecked without there ultimately being adverse environmental consequences. The approximately 20% of "air" that is presently oxygen, is present because of previous photosynthesis that "split" the naturally occurring carbon dioxide, and placed the carbon in various rocks, including those that were to be identified as fossil fuel, and released the oxygen into the atmosphere. Prior to the first photosynthesis there was less than 2% oxygen in the atmosphere by total volume. If the water vapour produced from the fuel-

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Hydrogen fuel might be made from a hydrogen source such as water, and once the energy has been produced and used, only release emissions of water vapour which might be subsequently trapped and reused to create more hydrogen. This would be a clean fuel. However, considerable quantities of energy have to be used to release the fuel-hydrogen. The question is clearly: "... is more or less energy used in its creation, than is derived from its use, and at what costs?" The answer is a function of the manner of its production (several ways are currently employed or have been tried) and in part of course, the answer is also influenced by the derived efficiencies of the manner of the fuel-hydrogen's use. In essence all systems currently consume more energy in production than they create.

As stated elsewhere:

> Although hydrogen is very clean coming out of the tailpipe, it is very dirty to manufacture. Almost all of the industrial hydrogen used today is produced from fossil fuels. Carbon is simply burned away from the fossil hydrocarbon, leaving the hydrogen behind. In terms of emissions per unit of energy produced, this process creates more greenhouse gas than any other fuel.
>
> A cleaner solution is through electrolysis of water. However, even this process is energy inefficient, requiring more energy than it yields in engine energy to generate the electricity to separate hydrogen from the oxygen. (Municipality of Metropolitan Toronto 1991)

Despite the obvious recognition that hydrogen, and preferably solar-hydrogen, is a long term solution rather than a measure that can realistically provide immediate benefits, or even benefits to be realised in the short term (next 10 to 20 years), it is appropriate to identify a list of the general advantages that hydrogen offers for the future:

a) hydrogen can be produced in great quantity in Canada from available water;

b) hydrogen is a gaseous fuel that could be "sold to the public" as both environmentally appropriate and

hydrogen process can be trapped so as to be subsequently split once more, and again using a renewable energy source such as solar energy, then hydrogen fuel is ultimately the ecological fuel of choice. Hydrogen fuel will not, however, permit us to continue to increase our energy consumption exponentially for ever, as would occur if we continue to permit current annual percentage increases of energy use.

producing better throttle response and easier cold weather starting than gasoline;

c) hydrogen has a higher octane rating than gasoline, permits higher engine compression ratios, can operate over a wide range of air/fuel mixtures, including leaner ones than gasoline, is less subject to engine quenching, and, therefore, results in a more energy efficient engine than a gasoline counterpart;

d) hydrogen is not a hydrocarbon and burns completely, therefore, no significant emissions of carbon monoxide or unburned hydrocarbons are produced (though it may produce relatively higher NOx emissions);

e) hydrogen is non-toxic and poses no direct health hazard; and

f) hydrogen, when stored in proper containers and handled with the proper equipment, can be safer than gasoline (it even disperses readily in the event of leakage - to which it is admittedly more prone - due to its low molecular weight).

(Ontario Ministry of Energy and Communications, 1985)

The major drawbacks of using hydrogen as a transportation fuel (after it has been produced) have yet to be fully overcome, and include:

a) hydrogen has a very low energy density, which makes it difficult to store hydrogen on board vehicles in adequate quantities, as either a compressed gas or as a liquid, and requires a 5 to 6 fold increase of tank size to provide a similar driving range to that of gasoline, or an equivalent increase in fill-up frequency;

b) hydrogen molecules are very small and hydrogen is, therefore, more prone to leakage than other fuels in either its gas or liquid state;

c) hydrogen combines with certain metals to form hydrides, causing embrittlement and weakening of the metals with which it comes in contact, as in engines and storage tanks; and

d) hydrogen is very expensive to produce when compared to other alternate fuels on a $/KJ basis.

(Ontario Ministry of Energy and Communications, 1985)

The questions of safety and storage can be resolved. Indeed, a fleet of vehicles using liquid hydrogen has been developed and tested by BMW in West Germany for several years. Equally, the cost of solar hydrogen is anticipated to become attractive in comparison to that of gasoline, on a distance travelled per unit of energy consumed basis, if fuel-cell motors (rather than modified internal combustion engines) come to be mass produced, as is suggested could occur by the year 2000 to 2010, though this may be an optimistic estimate.

CLEAN GASOLINE AND PRE-COMBUSTION VERSUS POST-COMBUSTION

That gasoline is dirty relative to alternate fuels is readily recognised. The petroleum industry has, however, been attempting to address the question by cleaning the gas. Recently, lead, a former additive, has been legislated out of gasoline and replaced by unleaded gasoline. In order to maintain the octane levels other additives have come to be included. These additives are considered to generate increased levels of air-borne toxics. Oxygenated compounds (such as methanol and ethanol) are added to encourage the more complete combustion of the gasoline within the in-cylinder combustion process. This reduces the emission of both airborne toxics and carbon monoxide. But use of oxygenates can increase smog production. The search for a "clean" gasoline continues. Clearly, its greatest benefit would be its immediate applicability in all internal combustion engines without engine modifications. But as the final fuel formulation is unknown, the environmental benefits remain speculative. More significantly, "clean gasoline" will not be able to reduce carbon dioxide emissions.

The search for improvement of present adopted technology also extends to the debate over pre-combustion and post-combustion solutions.

Pre-combustion solutions are considered by many to be preferable because they cause fuel to be burnt more efficiently, and therefore, waste less of a limited resource, and also because they produce less of the "greenhouse gas" - carbon dioxide. Better ways of delivering fuel to the cylinders and igniting it at the right moment can be achieved by such means as replacing carburettors and distributors with microchip controlled electronic fuel injection and electronic ignition. (Such replacements are neither readily available nor legal in Canada). This reduces emissions of carbon monoxide and hydrocarbons but does little to lower the quantities of oxides of nitrogen emitted. This can be done, for example, by adopting exhaust gas recycling (EGR), or lean burn, or turbocharger technologies in conjunction with electronic ignition and fuel injection. The "lean burn" engines are so-called because by minimizing the peripheral quenching of the combustion flame and by promoting a more complete combustion, they can operate at a leaner ratio (fuel to air) setting. However, this technology is still in its infancy.

The post-combustion option is currently seen as the only workable system to meet present emission guideline levels. Catalytic converters and non-lead fuel has been accepted as the appropriate solution. Early converters were expensive, performance inhibiting, and required the more expensive lead-free fuel (lead deactivates the catalysts). More recent catalytical converters incorporate oxidation and reduction in a so-called three-way converter (TWC). In a TWC palladium increases the oxidation of carbon monoxide and the hydrocarbons, and rhodium helps to reduce the oxides of nitrogen. TWC's also incorporate an oxygen probe (Lambda sensor) to monitor and regulate the volume and ratio of the fuel to air mixture. Modern converters do not restrict performance as did the early ones. However, the perception among many "do-it-yourselfers" or weekend-mechanics has been that performance is improved by by-passing or removing the catalytic converters. The disadvantage of TWC's is their complexity and high price, their need to be coupled with a well tuned engine for the TWC to operate efficiently, their higher fuel consumption (because of richer mixture requirements), and their reduced durability under faster driving environments.

EMISSION RATES OF ALTERNATE FUELS

It is necessary to address the question of which alternate fuel is most or least desirable from the standpoint of emissions produced?

The following Emission Rate Summary for Various Alternative Fuels (grams/mile) is compiled from CARB (California Air Resources Board) 1989 (as reproduced in a pro CNG paper), and from an Environmental Protection Agency (EPA) paper of April 1990.

Fuel	**Exh ROG**	**Evap ROG**	**CO**	**NO_x**
Gasoline	.35	.04	1.4	.66
M85	.25	.09	1.0	.45
M100	.56	.14	1.5	.48
E95	.94	.03	1.9	.50
E85	1.02	.05	1.8	.61
Propane	.20	0.00	1.4	.27
CNG	.19	0.00	.1	.44
CNG/Gas (dual fuel)	.23		0.5	.97
CNG/Gas (dual fuel)	.28		4.6	.67

where:

ROG = Reactive Organic Gases (hydrocarbons)
M85 = Methanol 85 percent
M100 = Methanol 100 percent
E95 = Ethanol 95 percent
E85 = Ethanol 85 percent
CNG = Compressed Natural Gas

Clearly, in this table CNG appears to be the alternate fuel of choice for all emissions other than NOx. However, dual fuel systems using CNG with gasoline are clearly almost as bad as gasoline in an overall assessment, and far worse in some respects than gasoline on its own (see below).

COMBINATION COMPATIBILITY PROBLEMS

It is salient to suggest that those who choose to be "environmentally conscientious" and install alternate fuel components in their vehicles, often for the best environmental motives though equally as frequently as an economy measure, commonly do so at the expense of emission quality

The optimum engine for one fuel may not be optimum for another. For example, natural gas (or CNG) has a very different optimum emission reduction "engine set-up" requirement than that for gasoline. The optimum for a CNG using engine, where optimum is simplified to imply a required lowering of CO emissions and high fuel efficiency, is best achieved using a higher compression ratio and leaner air to fuel ratios (lean burn) than gasoline. The optimum setting for a gasoline powered engine normally includes a lower compression ratio.

Where a dual propane and gasoline system is employed it is again a compromise between the ideals of both fuels in order to ensure acceptable vehicle performance. Dedicated propane vehicles need to use restrictions on the amount of intake manifold heat by blocking off the heat riser passage between the exhaust and intake manifolds in order to ensure a lower temperature for combustion, and to lower the density of the propane-air mixture and, therefore, increase the power output. But for gasoline engines, the intake manifold heat is needed to vaporize the gasoline in the air-gas mixture so as to facilitate cold starting. Also, propane needs more spark to ignite it than does gasoline, and propane also needs a different spark advance curve.

Equally, where dual fuel systems are installed, the almost unavoidable compromise in the past has been to use a carburettor setting halfway between rich and lean. Such compromise normally produces a net result of less carbon monoxide (CO) and hydrocarbon (HC) but more oxides of nitrogen (NOx). The use of in vehicle micro-computer chips to control the fuel-air ratios in fuel injection systems, based on the fuel being used, is a technology that offers considerable encouragement for the greater use of dual fuel systems in the future.

RETROFIT AND ALTERNATE FUEL CONVERSION PROBLEMS

Older motor vehicles still in use, such as those built in the late sixties or early seventies, seemingly contribute more emissions per vehicle kilometre travelled than the average, and certainly produce far more than current motor vehicles. Indeed, while acknowledging the existence of exceptions, older vehicles could be said to be the major component of urban air pollution in Toronto.

Removing such old vehicles from the roads is an obvious option, but one that tends to have adverse social equity impacts. Retrofitting older vehicles to accommodate the better technologies of the present is sometimes offered as an alternate solution. This should not be regarded as an automatic answer.

Removing manufacturer installed emission-related equipment is officially prohibited under Section 21 (2) and (3) of EPA and R.S.O. 1980, c. 141, s. 22. The Act seemingly precludes the installation of 'improvements' with respect to pollution control systems or anything that effects it. This includes replacing carburettors with a fuel injection system. The latter are generally regarded as superior to carburettor systems and require less idling in order to attain engine operating temperature in colder weather.

Companies "get around the regulations" by requesting experimental waivers. This is necessary for any vehicle conversion so that it can legally operate on alternate fuels, but this is not easily or readily applicable for all private cars.

Other problems:

- All conversions will require additional gas tank installation. Owners are unlikely to replace a gasoline tank with similar shaped "gas-vapour" tank.
- Installing propane or other gas cylinders in a hatchback type vehicle may be unsafe.

- Seemingly all retrofit combination systems suffer compatibility problems.

Conversion Costs

The typical propane conversion of an automobile or light truck is approximately $1,500. The estimated payback takes up to two years.

The typical CNG conversion for auto or light truck costs $2,300 to $3,000 (federal government gives $500 rebate). The estimated payback is from one to three years.

Ontario Government Initiatives include:

Sales tax removed on dedicated alternative fuel and dual fuel vehicles.

Sales tax removed from vehicles equipped with propane system to a maximum of $750 and from the components of a propane fuel system. Road tax on propane fuel is removed ; some 50,000+ propane vehicles are now on the roads of Ontario.

CNG sales tax removed to a maximum of $1,000.

Some alternative fuels have $1,000 rebate.

Gas Guzzle surcharge removed on fuel-inefficient cars (large number of cylinder passenger cars) if fitted with dedicated alternative fuels systems.

Sources: Ontario Ministry of Energy and Communications 1985. *Alternative Transportation Fuels: Hydrogen.* Transportation Energy Management Program (TEMP).

Municipality of Metropolitan Toronto 1991. Report to the Economic Development and Planning Committee on Alternative Fuels; February 8.

APPENDIX 12

Overview of Public Education Campaigns Around the World

LOCATION	PROGRAM TYPE	PROGRAM COMPONENTS	OUTCOME/EVALUATION
Ontario Municipal Transportation Energy and Efficiency Advisory Committee (MTEEAC)	Ride sharing	Share-A-Ride program with brochures, newsletters, rider-driver matching software; fuel economy program, "Drive Save Zone" film; driving instructor's manual and videos called "Planning Smarter, Driving Smoother" and "Easy Goin'"; plans to launch further public education campaign in 1991.	Needs to be publicized more, in use only with selected large companies.
Boston Caravan for Commuters - non profit organization	Van/Ride sharing programme	Commuter Hotline with info on alternatives and matching riders; highway signs; newsletter distributed through fastfood outlets, laundromats, news stands; customized employer programs; arranges transit subsidy to employees.	Aiming for higher vehicle occupancy overall, not reduction in emissions.
New York City Transportation Alternatives - non profit organization	Bicycle Promotion	Promote special alternative transit events, bike and non-bike; air PSA with pollution info. and bike stats; newsletter and Clean Air demonstrations; lobbying.	Have increased membership 40% in last year, won bylaw changes for cycle access to main streets; aiming for reduction of traffic accidents by educating cyclists, pedestrians and motorists to share street space.
Vancouver Task Force on Atmospheric Change - Municipality of The City of Vancouver	Traffic Management and Trip Reduction	Recommendation of By-laws with info to employers and public including: encouraging city leaders to set examples; info on tax notices, paycheques, all mailings; encouraging "green" neighbourhood demonstration projects; info kits with suggestions for action. All recommendations approved and passed by council, awaiting action.	Target 1) end all use of products containing ozone depleting chemicals by 1995. Target 2) Immediately reducing emissions levels of sulphur dioxide and methane. Target 3) 20% reduction in 1988 level carbon dioxide emissions by the year 2005. Goal is to reduce air pollution by reducing the number of commute trips during 6 a.m. to 10 a.m. peak traffic period.
Lyon, France City Council	Transit promotion	Civic officials are given bus and train passes instead of company cars.	Information not available.

LOCATION	**PROGRAM TYPE**	**PROGRAM COMPONENTS**	**OUTCOME/EVALUATION**
Oxford City Council	Transit Promotion	Civic officials are given employee bikes.	Information not available.
Winnipeg Welcome Wagon - non profit organization	Public Transit Promotion	Distribution of transit information with their Welcome Wagon, bus guides and schedules.	Information not available.
Ottawa Ottawa-Carleton Regional Transit Commission (OC Transpo)	Public Transit Promotion	Transit Challenge Day to improve community awareness - slogan "take the bus to a better environment"; transit employees on the look out for first-time riders; handed out system guides; radio broadcasts from specially painted buses; off peak fare maintained all day; special "spot the celebrity" contest.	Results: 30,000 extra trips, exceeded target by almost 3 times; 700 radio PSA's, half were free; three free press ads; high level of public response to survey; awarded local "Earth Angel" energy award.
Phoenix Arizona Energy Department - State wide program	Traffic and fuel reduction	School curriculum (k-12); "Plan It For The Planet" contest; Air Quality Programme has developed voluntary "Don't Drive One In Five"; PSA's and info for weather reports, TV and radio; promoted a Free-Bus Day and Commuting Day. Clean Air Force Campaign's new theme: "Every 25 miles adds a pound of pollution. Lose a Pound a Week"; points out savings of alternate forms of transportation (carpool - save up to $1000 a year!); Arizona Capitol Rideshare Parking Permit entitles riders to special parking - "The Drive Line Newsletter" has commuter stories, facts and tips, variable workhours and work at home plans.	Net average for the 1988 '89 campaign indicated a daily reduction in the 24 hour traffic of 2.8% in vehicle miles travelled, or 1.4 million miles equiva lent to the elimination of 27 tons of carbon monoxide per day and 35 tons of total pollutants. 35,000+ new riders rode on Free Bus Day. Most common ways drivers participated in campaign was: carpooling, 43%; eliminating or consolidating trips,37%; riding bus, 10%. Campaign generated 125+ newspaper articles, 100 TV features, and 800 "Don't Drive" TV news reminders combining to yield almost 110 million consumer impressions.
Barcelona City Council, Departments of Health, Public Health, & Environment	Clean Air Campaign	City established "Plan for the Decontamination of the Atmosphere" (slogan: "Going for a Better Environment") and a) public talks to encourage collaboration and participation; b) series of info pamphlets indicating	Information not available.

LOCATION	PROGRAM TYPE	PROGRAM COMPONENTS	OUTCOME/EVALUATION
		alternatives to pollution producing transportation & heating; c) Urban Environmental Centre - info distribution with educational programmes; d) "Urban Cleanliness" Campaign.	
Toronto Toronto's Environmental Protection Office. Municipal Government	Environmental Awareness	People's Guide to Environmental Protection has information on Cars and their effect on the Environment - handy, pocket sized with suggestions for change.	Information not available.
Gothenburg, Sweden International conference - Municipal effort	Environmental Campaign	Proclaimed 1989 environmental year with promotion of new Environmental Technology Centre "S:t Jörgens Park", new clean trolley transit and special edition of Market-place Sweden which presented many examples of ads and articles on emission and traffic reduction. One ad parallels the quality of life and the quality of travel, promoting mass transit.	Information not available.
Fairland/White Oaks, Maryland County and State Government	Trip Reduction Program	Typical Ride Share program as part of legislation for developers, includes press release indicating company, promotional material which is distributed to new home owners in the area, newsletter, rider/driver matching program.	The Goal of the initial agreement was for the reduction of at least 180 vehicle trips within the area during the peak hours in the peak direction.
Toronto CBC National Radio and TV network	Environmental Awareness	Communications Station has produced handout "It's A Matter of Survival; The next step..." with information on transportation and suggestions for change.	Information not available.
Toronto City Cycling Committee. Municipal	Cycle Promotion	Encourages and promotes use of bicycles and addresses basic barriers by improving safety for cyclists, increasing	The Committee proposes to install 1,000 new bike racks/year for next five years, up from 200. New goals include studying

LOCATION	PROGRAM TYPE	PROGRAM COMPONENTS	OUTCOME/EVALUATION
		bike parking facilities, shower & change rooms; promotes practical and personal benefits; organizes "Bike to Work Week" event including breakfast stops, open houses, info booths, incentives, shows, seminars.	major commuter routes in the city core; expanding last year's successful Bike to Work week into an ongoing outreach program; developing a campaign to increase bike helmet use among children.
Erlangen, Germany Municipal	Cycle Promotion	City started a bicycle-friendly campaign with slogan "Progressive People use Bicycles" which ran in conjunction with its bicycle path improvement programme.	Information not available.
Arcata, California County and state government	Alternative Transportation Promotion	City planned an "Alternative Transportation Day" providing free bus service" using newsletters, TV and radio ads to promote limit-ing use of cars by walking, riding a bike, using public transit or carpooling.	Information not available.
Ottawa Citizens Group	Walking Promotion	Ottawalk: Ottawa and Area Pedestrians. Organizes walks, works to improve pedestrian safety and promotes walking to a)get and stay fit b) avoid polluting the air c) save money on other forms of transportation d) freeing up road space and reducing highway expenditures.	Information not available.
California South Coast Air Quality Management District - Multi-county regulation, research and communications body. Commuter program has corporate support.	Emission Reduction and Trip Reduction Program (legislated)	Patrol for smoking vehicles; Call 1-800-CUT-SMOG; Commuter program to achieve legislated levels required by all employers of 100+ employees and other interested parties.	Information not available.